vi30/vi40 Laser

User Manual

Novanta

ENGINEERED BY SYNRAD

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Important Information

For your protection, carefully read these instructions before installing and operating the scan head.
Retain these instructions for future reference.

Novanta reserves the right to update this user manual at any time without prior notification.

If product ownership changes, this manual should accompany the product.

DANGER: Indicates a hazardous situation which, if not avoided, will result in serious injury or death. Its use should be limited to the most extreme situations.

WARNING: Indicates a hazardous situation which, if not avoided, could result in serious injury or death.

CAUTION: Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Important: Indicates information considered important but not directly hazard related (e.g., security, hygiene, or equipment or property damage).

Safety Labels

DANGER: Laser radiation can cause severe retinal and corneal burns, burns on the skin, and may pose a fire risk. To avoid injury and reduce risk of fire, please follow the control measures and safety guidelines provided by the laser's manufacturer, and those established by your Laser Safety Officer (LSO), Radiation Safety Officer (RSO), or safety department of your business or institution.

ESD Warning
MOVIA scan heads are electrostatic discharge-sensitive devices (ESD). The equipment should remain sealed until the user is located at a proper static control station; improper handling could cause damage to these electronics.

A proper static control station should include:

A soft grounded conductive tabletop or grounded conductive mat on the tabletop.

A grounded wrist strap with the appropriate (1 MΩ) series resistor connected to the tabletop mat and ground.

An adequate earth ground connection, such as a water pipe or AC ground.

Conductive bags, trays, totes, racks, or other storage.

Properly grounded power tools.

Personnel handling ESD items should wear ESD protective garments and ground straps.

Important: Equipment returned to the factory must be shipped in anti-static packaging.

Important: Customers assume all responsibility for maintaining a laser-safe working environment. Original equipment manufacturer (OEM) customers assume all responsibility for CDRH (Center for Devices and Radiological Health) certification.

Customer Support

Before contacting Novanta for assistance, review appropriate sections in the manual that may answer your questions.

After consulting this manual, please contact one of our worldwide offices between 9 AM and 5 PM local time.

Americas, Asia Pacific

Novanta Headquarters, Bedford, USA
Phone: +1-781-266-5700
Email: photonics@novanta.com

Europe, Middle East, Africa

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Email: photonics@novanta.com

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Phone: +39-039-793-710
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Email: photonics.china@novanta.com

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Japan

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Email: photonics.japan@novanta.com

Trademark & Copywrite

Warranty Information

This is to certify that vi30/40 lasers are guaranteed by NOVANTA to be free of all defects in materials and workmanship for a period of one year from the date of purchase. This warranty does not apply to any defect caused by negligence, misuse (including environmental factors), accident, alteration, or improper maintenance. We request that you examine each shipment within 10 days of receipt and inform NOVANTA of any shortage or damage. If no discrepancies are reported, NOVANTA shall assume the shipment was delivered complete and defect-free.

If, within one year from the date of purchase, any part of the laser should fail to operate, contact the NOVANTA Customer Service department at 1.800.NOVANTA1 (outside the U.S. call 1.425.349.3500) and report the problem. When calling for support, please be prepared to provide the date of purchase, model number and serial number of the unit, and a brief description of the problem. When returning a unit for service, a Return Authorization (RA) number is required; this number must be clearly marked on the outside of the shipping container for the unit to be properly processed. If replacement parts are sent to you, then you are required to send the failed parts back to NOVANTA for evaluation unless otherwise instructed.

If your vi30/40 laser fails within the first 45 days after purchase, NOVANTA will pay all shipping charges to and from NOVANTA when shipped as specified by NOVANTA Customer Service. After the first 45 days, NOVANTA will continue to pay for the costs of shipping the repaired unit or replacement parts back to the customer from NOVANTA. The customer, however, will be responsible for shipping charges incurred when sending the failed unit or parts back to NOVANTA or a NOVANTA Authorized Distributor. To maintain your product warranty and to ensure the safe and efficient operation of your vi30/40 laser, only authorized NOVANTA replacement parts can be used. This warranty is void if any parts other than those provided by NOVANTA are used.

NOVANTA and NOVANTA Authorized Distributors have the sole authority to make warranty statements regarding NOVANTA products. NOVANTA and its Authorized Distributors neither assumes nor authorizes any representative or other person to assume for us any other warranties in connection with the sale, service, or shipment of our products. NOVANTA reserves the right to make changes and improvements in the design of our products at any time without incurring any obligation to make equivalent changes in products previously manufactured or shipped. Buyer agrees to hold NOVANTA harmless from all damages, costs, and expenses relating to any claim arising from the design, manufacture, or use of the product, or arising from a claim that such product furnished Buyer by NOVANTA, or the use thereof, infringes upon any Patent, foreign or domestic.

Sales, Application & Support

Novanta Sales and Support

NOVANTA® worldwide headquarters are located north of Seattle in Mukilteo, Washington. U.S.A. Our mailing address is:

NOVANTA 4600 Campus Place Mukilteo, WA 98275 U.S.A.

Phone us at:

1.800.NOVANTA1 (1.800.796.7231)

Outside the U.S.:

+1.425.349.3500

Fax:

+1.425.349.3667

E-mail:

Novanta@Novanta.com

Sales & Application

NOVANTA Regional Sales Managers work with customers to identify and develop the best CO2 laser solution for a given application. Because they are familiar with you and your laser application, use them as a first point of contact when questions arise. Regional Sales Managers also serve as the liaison between you and our Applications Lab in processing material samples per your specifications. To speak to the Regional Sales Manager in your area, call NOVANTA at 1.800. NOVANTA1.

Customer Service

For assistance with order or delivery status, service status, or to obtain a Return Authorization (RA) number, contact NOVANTA at 1. 800.NOVANTA1 and ask to speak to a Customer Service representative, or you can email us by sending a message to customercare@Novanta.com.

Technical Support

NOVANTA Regional Sales Managers can answer many technical questions regarding the installation, use, troubleshooting, and maintenance of our products. In some cases, they may transfer your call to a Laser, Marking Head, or Software Support Specialist. You may also e-mail questions to the Technical Support Group by sending your message to Novanta tech support Novanta.com.

Reference Materials

Your Regional Sales Manager can provide reference materials including Outline & Mounting drawings, Operator's Manuals, Technical Bulletins, and Application Newsletters. Most of these materials are also available directly from the NOVANTA web site at http://www.Novanta.com.

EU Headquarters

For assistance in Europe, contact NOVANTA® European subsidiary, NOVANTA Europe, at:

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Parkring 57-59

85748 Garching bei München,

Germany

Phone: +49 89 31707-0

web: www.Novanta.com

E-mail: EMEA-service@novanta.com

For assistance in China, contact NOVANTA® at:

Novanta China Sales and Service Center

2401-J, Bak Building, Hi-tech Park, Nanshan District Guangdong, PRC 518057

Phone: +86 (755) 8280 5395

Fax: +86 (755) 8672 1125

E-mail: sales-china@Novanta.com

web: www.Novanta.com

Guidelines & Content

Refer to the drawings, located in the technical reference chapter, when installing and operating your vi30/40 laser. Also reference the vi30/40 quick start guide located on our website.

- Unpacking/Packing

  Storage/Shipping

  Mounting/Connecting/Cooling

- vi/40 nomenclature/ features

NOVANTA recommends saving all of the laser's original packaging. It's unique design assists in preventing damage to your laser during storage, relocation and/or shipping.

Reference our Quick Start Guide Series at Novanta.com. Additional information can also be found in the Technical Reference section within this manual.

Contents description

Each item below is also listed in tables that follow:

OEM vi30/40 Laser – for cutting, welding, drilling, and marking a wide variety of products and materials.

Customer Communication Flier vi30/40- Instead of the laser manual CD, please follow the instructions for our latest laser manual(s) located here: http://www.synrad.com/Manuals/manuals_laser.htm.

Mounting bolts – Three each 1/4-20 x 5/8 UNC caps crews are provided for fastening the vi30/40 laser to your mounting surface.

Spare Fuse – Two fast-blow vi30 12 A Cooper Bussmann BK/ABC-12-R or RoHS equivalent (novanta P/N 521-00058-01), fast-blow fuses and two fast-blow vi40 20 A Cooper Bussmann ABC-20-R or equivalent 20 A (novanta P/N521-00005-01), fast-blow fuses incorporated into the positive DC power cable protects the laser's internal circuitry. See Troubleshooting in the Maintenance and Troubleshooting chapter for additional information.

Final Test Report (not shown) – Contains data collected during the laser's final pre-shipment test.

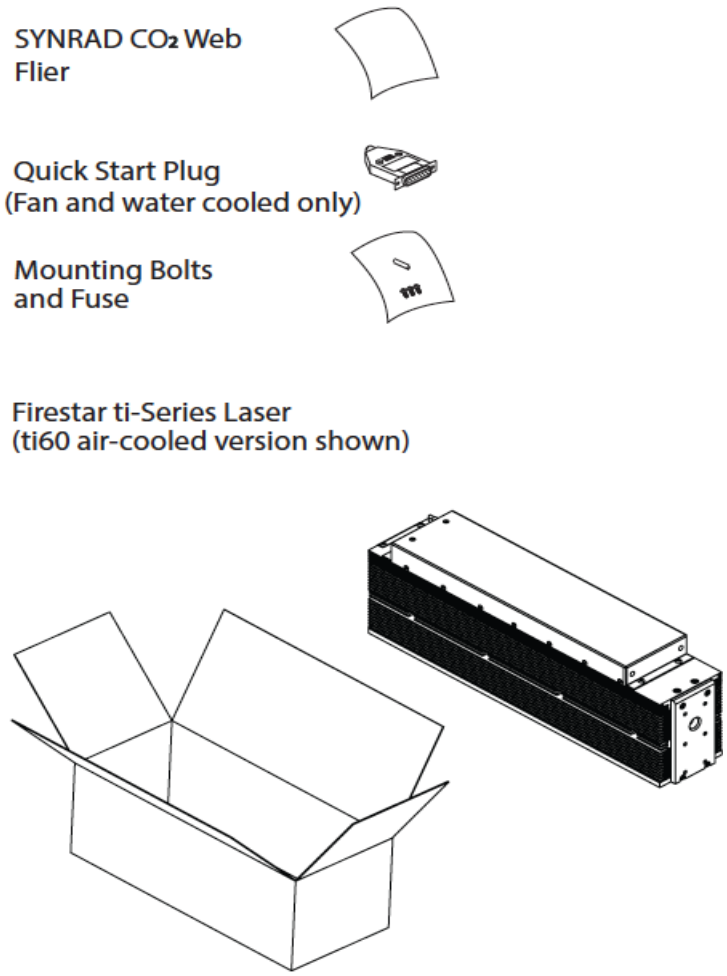

Figure 1-1 vi30/40 ship kit contents.

Table 1-1 vi30/40 ship kit contents

Only with fan and water-cooled models

Shipping Box Contents	Qty
vi30/40 Laser	1
Customer Flier	1
Cooling kit	1
DC power cable set (not shown)	1
Mounting Bolts	3
Spare Fuse	4
Final Test Report (not shown	1

Nomenclature

- Model numbers
- vi30/40 laser versions

The last three characters in the Firestar model number serve to designate the functional category, cooling method, and model version. The functional category is indicated by either a “K” for Keyswitch or “S” Standard (OEM) for OEM models. The next letter indicates the cooling method: “W” for water-cooled units, “F” for fan-cooled units, and “A” for air-cooled lasers (where the customer must provide the proper cooling via fans or blowers). The last letter in the model number indicates the current model version beginning with “B.” For example, the model number FSVi30SAB designates the vi30 laser as a standard OEM, air-cooled version B.

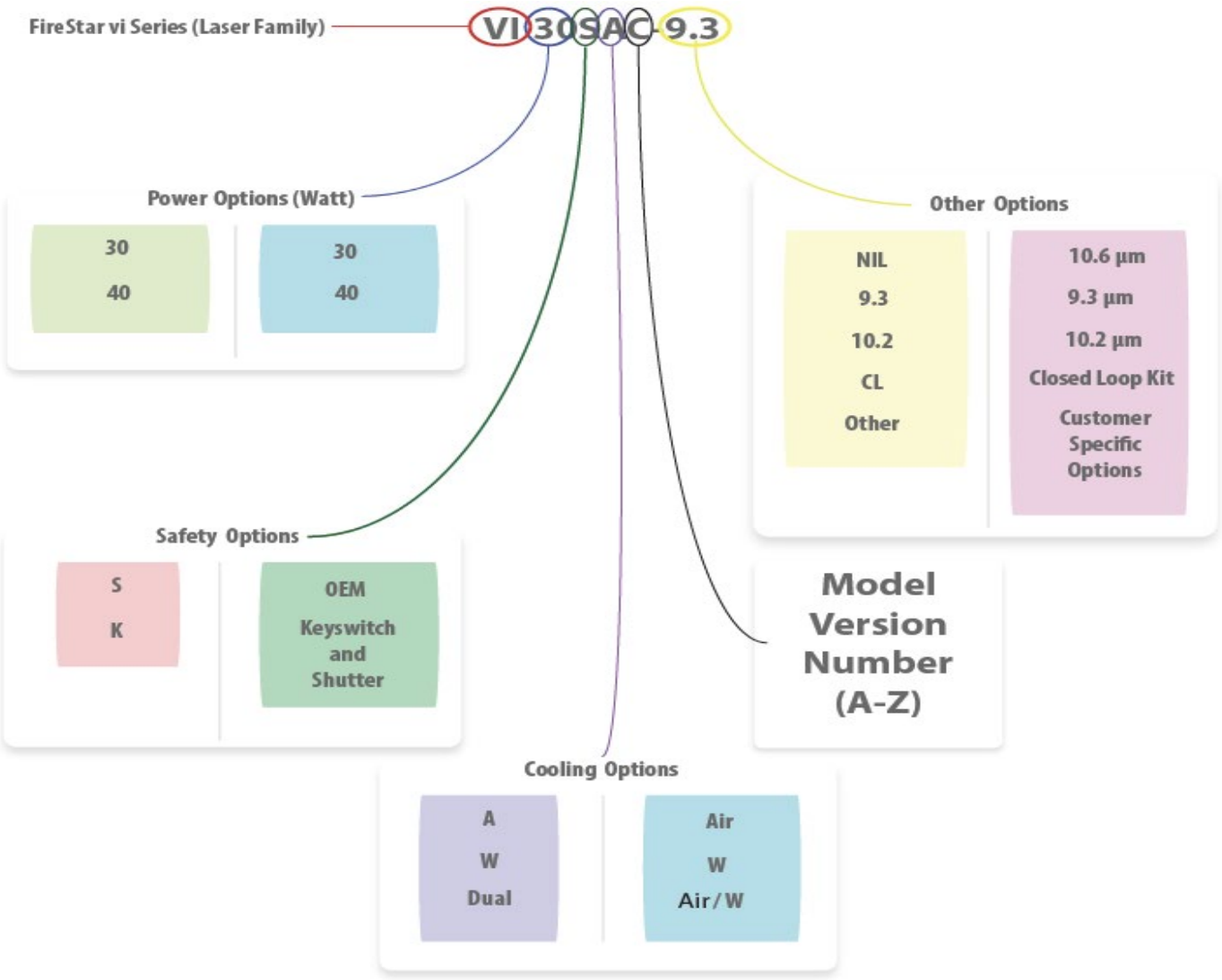

Figure 1-2 Anatomy of a model number.

Laser Safety

Read the entire safety section. This will ensure you are familiar with the hazards and warnings prior to starting.

- Hazard Information – includes equipment label terms and hazards, please familiarize yourself with all definitions and their significance.
- General & Other Hazards – provides important information about the hazards and unsafe practices that could result in death, severe injury, or product damage.
- Disposal – information on your vi30/40 laser parts and/or components as they pertain to disposal.
- Additional Safety Information – describes how to find additional information about your laser.
- Compliance – explains in the subsections therein applicable and appropriate regulation information.

Warning: Serious Personal Injury

Safety Data sheets (SDS) for materials processed should be evaluated and the adequacy of provisions for fume extraction, filtering and venting should be carefully considered.

This Class 4 CO2 laser product emits invisible infrared laser radiation in the 9.3–10.6 µm wavelength band.

Because direct or diffuse laser radiation can inflict severe corneal injuries, always wear eye protection when in the same area as an exposed laser beam. Do not allow the laser beam to contact a person!

This product emits an invisible laser beam that is capable of seriously burning human tissue. Always be aware of the beam's path and always use a beam block while testing.

Hazard Information

Hazard information includes terms, symbols, and instructions used in this manual or on the equipment to alert both operating and service personnel to the recommended precautions in the care, use, and handling of Class 4 laser equipment.

Terms

Certain terms are used throughout this manual or on the equipment labels. Please familiarize yourself with their definitions and significance.

- Warning: Potential & Imminent hazards which, if not avoided, could result in death or serious injury. Alerts operator of serious dangers, hazardous radiation, hazardous voltages, vapor hazard, & reflective dangers.
- Danger: Hazards which, if not avoided, could result in minor or moderate injury. Alerts operator of lifting dangers.
- Caution: Potential hazards or unsafe practices which, if not avoided, may result in product damage. Alerts operator of equipment dangers.
- Important note: Content specific information and/or recommendations.

Warning: Serious Personal Injury

For laser systems being used or sold within the U.S.A., customers should refer to and follow the laser safety precautions described American National Standards Institute (ANSI) document Z136.1-2014, Safe Use of Lasers.

For laser systems being used or sold outside the U.S.A., customers should refer to and follow the laser safety precautions described in European Normative and International Electrotechnical Commission documents IEC/ TR 60825-14:2014, Safety of Laser Products – §14: A User's Guide.

Following are descriptions of general hazards and unsafe practices that could result in death, severe injury, or product damage. Specific warnings and cautions not appearing in this section are found throughout the manual.

Warning: Serious Personal Injury

Enclose the beam path whenever possible. Exposure to direct or diffuse CO2 laser radiation can seriously burn human or animal tissue, which may cause permanent damage.

This product is not intended for use in explosive, or potentially explosive, atmospheres!

Materials processing with a laser can generate air contaminants such as vapors, fumes, and/or particles that may be noxious, toxic, or even fatal.

Safety Data Sheets (SDS) for materials being processed should be thoroughly evaluated and the adequacy of provisions for fume extraction, filtering, and venting should be carefully considered. Review the following references for further information on exposure criteria:

ANSI Z136.1-2014, Safe Use of Lasers, § 7.3.

U.S. Government's Code of Federal Regulations: 29 CFR §1910, §§ Z.

Threshold Limit Values (TLV's) published by the American Conference of Governmental Industrial Hygienists (ACGIH).

It may be necessary to consult with local governmental agencies regarding restrictions on the venting of processing vapors.

The use of aerosol dusters containing difluoroethane causes "blooming," a condition that significantly expands and scatters the laser beam. This beam expansion can affect mode quality and/or cause laser energy to extend beyond the confines of optical elements in the system, damaging acrylic safety shielding. Do not use air dusters containing difluoroethane in any area adjacent to CO2 laser systems because difluoroethane persists for long time periods over wide areas.

Light hazards

Lasers should be installed and operated in manufacturing or laboratory facilities by trained personnel only. Due to the considerable risks and hazards associated with the installation and operational use of any equipment incorporating a laser, the operator must follow product warning labels and instructions to the user regarding laser safety. To prevent exposure to direct or scattered laser radiation, follow all safety precautions specified throughout this manual and exercise safe operating practices per ANSI Z136.1-2014, Safe Use of Lasers always when actively lasing.

Due to the specific properties of laser light, a unique set of safety hazards that differ from other light sources must be considered. Just like light, lasers can be reflected, refracted, diffracted, or scattered.

A CO_2 laser is an intense energy source and will ignite most materials under the proper conditions. Never operate the laser in the presence of flammable or explosive materials, gases, liquids, or vapors.

Safe operation of the laser requires the use of an external beam block to safely block the beam from traveling beyond the desired work area. Do not place your body or any combustible object in the path of the laser beam. Use a water-cooled beam dump or power meter, or similar non-scattering,

noncombustible material as the beam block. Never use organic material or metals as the beam blocker; organic materials, in general, are apt to combust or melt and metals act as specular reflectors which may create a serious hazard outside the immediate work area.

 Warning: Serious Personal Injury

Always wear safety glasses or protective goggles with side shields to reduce the risk of damage to the eyes when operating the laser.

The use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure

Never use organic materials or metals as a beam blocker. There are very few exceptions, eg. Black anodized metal such as aluminum because this is non reflective surface.

Other hazards

The following hazards are typical for this product family when incorporated for intended use:

(A) risk of injury when lifting or moving the unit; (B) risk of exposure to hazardous laser energy through unauthorized removal of access panels, doors, or protective barriers; (C) risk of exposure to hazardous laser energy and injury due to failure of personnel to use proper eye protection and/or failure to adhere to applicable laser safety procedures; (D) risk of exposure to hazardous or lethal voltages through unauthorized removal of covers, doors, or access panels; (E) generation of hazardous air contaminants that may be noxious, toxic, or even fatal.

Thorium Safety

- This laser system incorporates a II-VI Infrared optical component.
- This optical component contains a small amount of thorium fluoride, a type of source material (less than 10% by weight).
- It is exempt from USNRC licensing regulations as an "unimportant quantity of source material" per 10 CFR 40.13(c) (7).
- Shaping, grinding, polishing, or alteration of the optical component is prohibited.
- Use of this optical component in contact lenses, spectacles, or in eyepieces in binoculars or other similar optical instruments is prohibited.

Cleaning optical components is permitted so long as care is taken not to damage the coated surface of the component as sold. This II-VI Infrared requirement only applies to lenses and optics manufactured and distributed by II-VI Infrared. Distributing components or devices that contain lenses and optics manufactured by other companies as if it were manufactured by II-VI Infrared is not in compliance with USNRC distribution requirements.

U.S. distribution of components or devices that contain lenses and optics manufactured by other companies which contain uranium and/or thorium requires a USNRC distribution license. Only II-VI Infrared manufactured lenses and optics which contain thorium are covered by the II-VI Infrared distribution license.

10 CFR 40.13(c) (7) Unimportant quantities of source material.

(7) Thorium or uranium contained in or on finished optical lenses and mirrors, provided that each lens or mirror does not contain more than 10 percent by weight thorium or uranium or, for lenses manufactured before August 27, 2013, 30 percent by weight of thorium; and that the exemption contained in this paragraph does not authorize either:

(i) The shaping, grinding, or polishing of such lens or mirror or manufacturing processes other than the assembly of such lens or mirror into optical systems and devices without any alteration of the lens or mirror; or

(ii) The receipt, possession, use, or transfer of uranium or thorium contained in contact lenses, or in spectacles, or in eyepieces in binoculars or other optical instruments.

Disposal

This product contains components that are considered hazardous industrial waste. If a situation occurs where the laser is rendered non-functional and cannot be repaired, it may be returned to NOVANTA® who, for a fee, will ensure adequate disassembly, recycling and/or disposal of the product.

Additional laser safety information

The NOVANTA web site https://www.Novanta.com/resources/general_information/lasersafetyresources contain an online laser safety handbook that provides information on (1) Laser Safety Standards for OEM's/System Integrators, (2) Laser Safety Standards for End Users, (3) References and Sources, and (4) Assistance with Requirements.

In addition, the Occupational Safety and Health Administration (OSHA) provides an online Technical Manual located at http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_6.html Section III, Chapter 6 and Appendix III are useful resources for laser safety information.

Another excellent laser safety resource is the Laser Institute of America (LIA). Their comprehensive web site is located at http://www.lia.org.

vi30 Laser label locations

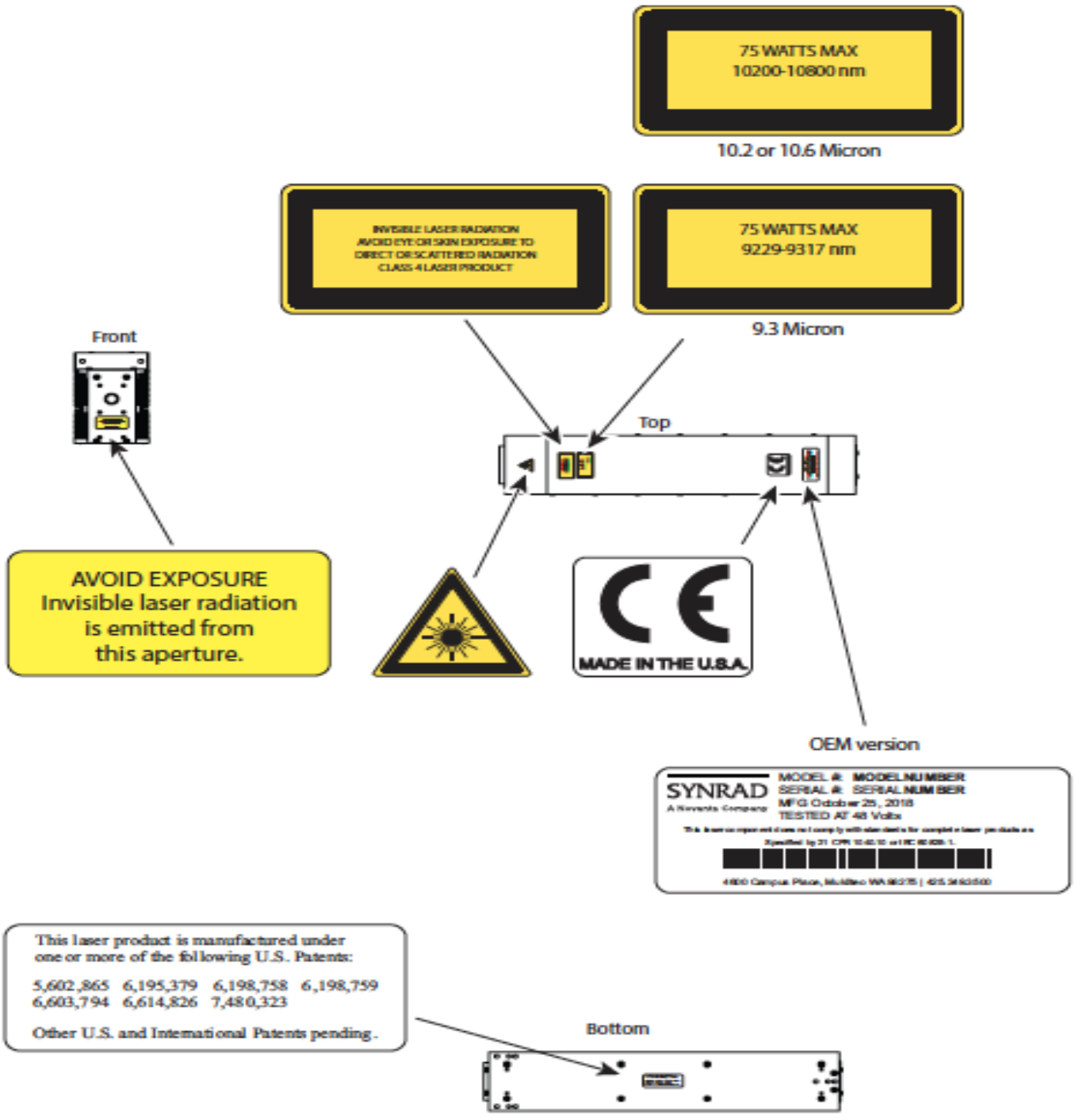

Figure 2-1 vi30 hazard label locations

vi40 Laser label locations

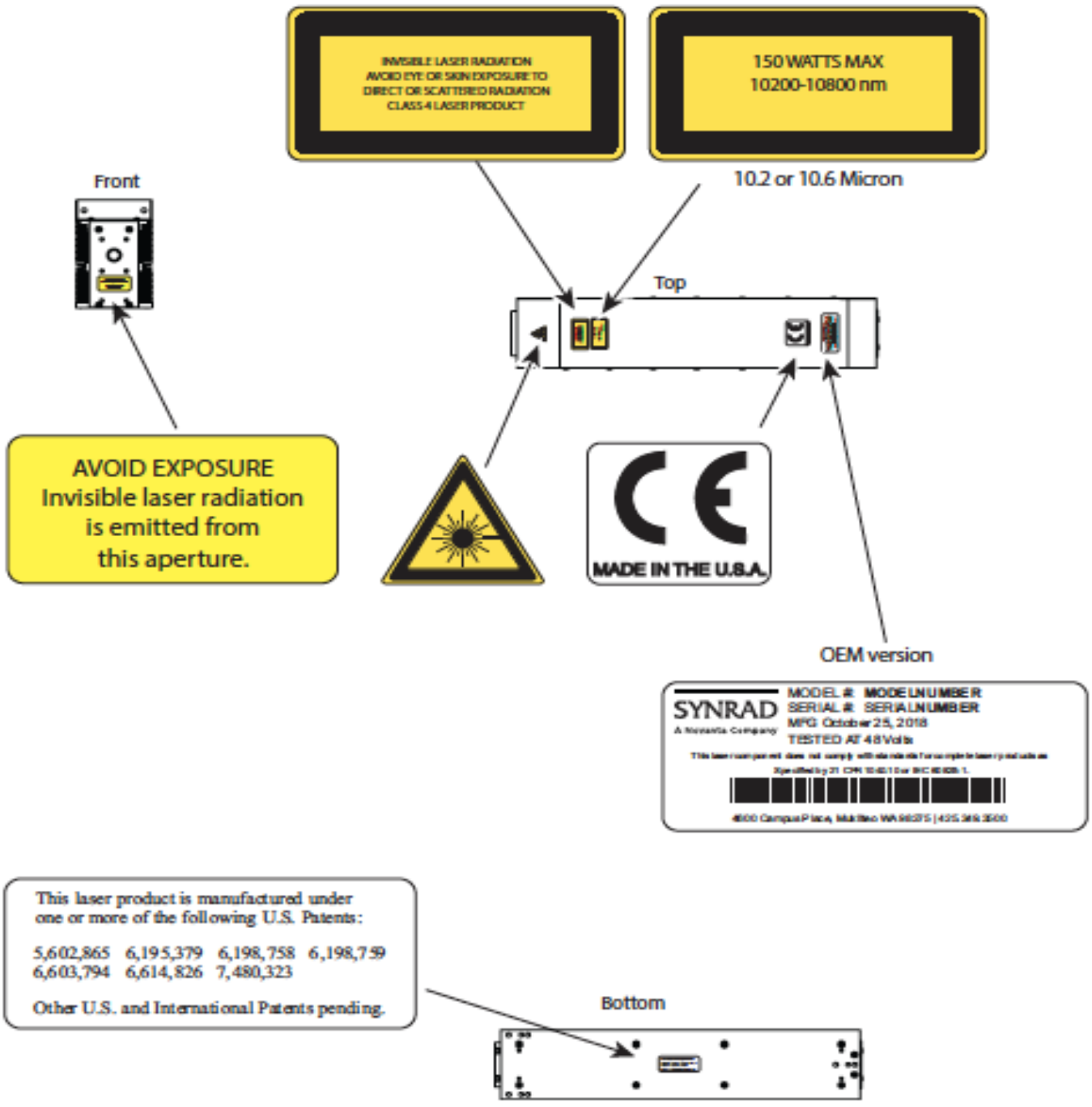

Figure 2-2 vi40 hazard label locations

Agency Compliance

- Center for Devices and Radiological Health (CDRH) requirements.
- Federal Communications Commission (FCC) requirements.
- European Union (EU) requirements.

NOVANTA® lasers are designed, tested, and certified to comply with certain United States (U.S.) and European Union (EU) regulations. These regulations impose product performance requirements related to electromagnetic compatibility (EMC) and product safety characteristics for industrial, scientific, and medical (ISM) equipment. The specific provisions to which systems containing vi lasers must comply are identified and described in the following paragraphs.

In the U.S., laser safety requirements are governed by the Center for Devices and Radiological Health (CDRH) under the auspices of the U.S. Food and Drug Administration (FDA) while radiated emission standards fall under the authority of the U.S. Federal Communications Commission (FCC). Outside the U.S., laser safety and emissions are governed by European Union (EU) Directives and Standards.

In the matter of CE-compliant laser products, NOVANTA assumes no responsibility for the compliance of the system into which the product is integrated, other than to supply and/or recommend laser components that are CE marked for compliance with applicable European Union Directives.

Because OEM laser products are intended for incorporation as components in a laser processing system, they do not meet all the Standards for complete laser processing systems as specified by 21 CFR, Part 1040 or EN 60825-1. NOVANTA assumes no responsibility for the compliance of the system into which OEM laser products are integrated.

Center for Devices and Radiological Health (CDRH) Requirements

Product features incorporated into the design of vi30/40 lasers to comply with CDRH requirements are integrated as panel controls or indicators, internal circuit elements, or input/output signal interfaces. Specifically, these features include a lase and laser ready indicators, remote interlock for power on/off, a laser aperture shutter switch, and a five-second delay between power on and lasing. Incorporation of certain features is dependent on the laser version (Keyswitch or OEM). See the Class 4 safety features, located in the following table, which indicate which features are available on vi30/40 lasers, the type and description of the feature, and if the feature is required by CDRH regulations.

OEM Models

vi30 OEM lasers are OEM products intended for incorporation as components in laser processing systems. As supplied by NOVANTA, these lasers do not meet the requirements of 21 CFR, Subchapter J without additional safeguards. In the U.S., the Buyer of these OEM laser components is solely responsible for the assurance that the laser processing system sold to an end user complies with all laser safety requirements before the actual sale of the system.

Under CDRH regulations, the Buyer must submit a report to the CDRH prior to shipping the system. In jurisdictions outside the U.S., it is the sole responsibility of the Buyer of these OEM components to ensure that they meet all applicable local laser safety requirements. In cases where the Buyer is also the end-user of the OEM laser product, the Buyer/end-user must integrate the laser so that it complies with all applicable laser safety standards as set forth above.

Federal Communications Commission (FCC) Requirements

The United States Communication Act of 1934 vested the Federal Communications Commission (FCC) with the authority to regulate equipment that emits electromagnetic radiation in the radio frequency spectrum. The purpose of the Communication Act is to prevent harmful electromagnetic interference (EMI) from affecting authorized radio communication services. The FCC regulations that govern industrial, scientific, and medical (ISM) equipment are fully described in 47 CFR, §18, §§C.

NOVANTA vi30/40 lasers have been tested and found to comply by demonstrating performance characteristics that have met or exceeded the requirements of 47 CFR, §18, §§C for Radiated and Conducted Emissions.

FCC Information to the user

Important Note: The following FCC information to the user is provided to comply with the requirements of 47 CFR, Part 18, Section 213.

Interference Potential

In our testing, NOVANTA has not discovered any significant electrical interference traceable to vi30/40 lasers.

System Maintenance

Ensure that all exterior covers are properly fastened in position.

Measures to Correct Interference

If you suspect that your laser interferes with other equipment, take the following steps to minimize this interference:

1. Use shielded cables to and from the equipment that is experiencing interference problems.

2. Ensure that the laser is properly grounded to the same electrical potential as the equipment or system it is connected to.

FCC caution to the user

The Federal Communications Commission warns the user that changes, or modifications of the unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

European Union (EU) requirements RoHS compliance

NOVANTA® vi30/40 lasers meet the requirements of the European Parliament and Council Directive 2015/863/EU on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment that establishes maximum concentration values for certain hazardous substances in electrical and electronic equipment.

Laser Safety Standards

Under the Low Voltage Directive, 2006/95/EC, the European Norm (EN) document EN 60825- 1:2007 was developed to provide laser safety guidance and includes clauses on Engineering Specifications, Labeling, Other Informational Requirements, Additional Requirements for Specific Laser Products, Classification, and Determination of the Accessible Emission Level. To develop a risk assessment plan/laser safety program for users, see IEC/TR 60825-14:2004 that includes clauses on Administrative Policies, Laser Radiation Hazards, Determining the MPE, As-sociated Hazards, Evaluating Risk, Control Measures, Maintenance of Safe Operation, Incident Reporting and Accident Investigation, and Medical Surveillance.

OEM Models

Vi30/40 OEM lasers are OEM products intended for incorporation as components in laser processing systems. As supplied by NOVANTA, these lasers do not meet the requirements of EN 60825-1 without additional safeguards. European Union Directives state that “OEM laser products which are sold to other manufacturers for use as components of any system for subsequent sale are not subject to this Standard, since the final product will itself be subject to the Standard.” This means that Buyers of OEM laser components are solely responsible for the assurance that the laser processing system sold to an end-user complies with all laser safety requirements before the actual sale of the system. Note that when an OEM laser component is incorporated into another device or system, the entire machinery installation may be required to conform to EN 60825-1:2004, EN 60204- 1:2016, Safety of Machinery; the Machinery Directive, 2006/42/EC; and/or any other applicable Standards and in cases where the system is being imported into the U.S., it must also comply with CDRH regulations.

In cases where the Buyer is also the end-user of the OEM laser product, the Buyer/end-user must integrate the laser so that it complies with all applicable laser safety standards as set forth above. TClass 4 safety features, summarizes product features, indicating the type and description of features and whether those features are required by European Union regulations.

Electromagnetic Interference Standards

NOVANTA vi30/40 lasers have demonstrated performance characteristics that have met or exceeded the requirements of EMC Directive 2014/30/EU.

The European Union’s Electromagnetic Compatibility (EMC) Directive, 2014/30/EU, is the sole Directive developed to address electromagnetic interference (EMI) issues in electronic equipment. In particular, the Directive calls out European Norm (EN) documents that define the emission and immunity standards for specific product categories. For vi30/40 lasers, EN 61000- 6-4:2018 defines radiated and conducted RF emission limits while EN 61000-6-2:2016 defines immunity standards for industrial environments.

vi30/40 lasers have demonstrated performance characteristics that have met or exceeded the requirements of EMC Directive 2004(2014)/108/EC.

Table 2-1 Class 4 safety features.

Feature	Location	Description	Required by: CDRH	EN60825-1	Available on: OEM vi30/40
Keyswitch[1]	Rear Panel Control	On/Off/Reset Key switch controls power to laser electronics. Key cannot be removed from switch in the "On" position.	Yes	Yes	No
Shutter Function[1]	Laser Control	Functions as a beam attenuator to disable RF driver/laser output when closed.	Yes	Yes	No
Shutter Function[1] (SHT)	Rear Panel Indicator (Blue)	Functions as a beam attenuator to disable RF driver/laser output when closed.	Yes	Yes	No
PWR (power) indicator	Rear Panel Indicator (Green)	Illuminates green to indicate DC power is applied.	No	No	Yes
Ready Indicator (RDY)	Rear Panel Indicator (Yellow)	Indicates that laser has power applied and is capable of lasing.	Yes	Yes	Yes
Lase Indicator	Rear panel indicator (Red)	Indicates that laser is actively lasing. Lase LED illuminates when the duty cycle of the command cycle is long enough to produce laser output.	No	No	Yes
Five second delay	Circuit Element	Disables RF driver/laser output for five seconds after Keyswitch is turned to "On" or remote reset/start pulse is applied when Keyswitch is in "On" position.	Yes	No	No
Power Fail Lockout[1]	Circuit Element	Disables RF driver/laser output if input power is removed then later reapplied (AC power failure or remote interlock actuation) while Keyswitch is in "On" position	Yes	Yes	No
Remote Interlock	Rear Panel Connection	(Laser Enable Input) Disables RF driver/laser output when a remote interlock switch on an equipment door or panel is opened.	Yes	Yes	Yes
Remote Interlock INT Indicator	Rear panel indicator (Green/Red)	Illuminates green when Remote Interlock circuitry is closed. Illuminates red when interlock circuitry is open.	No	No	Yes
Over Temperature Protection	Circuit Element	Temperature shutdown occurs if temperature of the laser tube rises above safe operating limits	No	No	Yes
Temp (TMP) indicator	Rear panel indicator (Green/Red)	Red when thermal limit exceed. Green when temp within limits	No	No	Yes

Warning Labels	Laser exterior	Labels attached to various external housing locations to warn personnel of potential laser hazards.	Yes	Yes	Yes

1 Not available nor required on vi Series OEM lasers.

When integrating NOVANTA vi30 OEM lasers, the Buyer and/or integrator of the end system is responsible for meeting all applicable Standards to obtain the CE mark. To aid this compliance process, NOVANTA testing program has demonstrated that vi30 lasers comply with the relevant requirements of Directive 2014/30/EU, the Electromagnetic Compatibility Directive, as summarized in table below.

Table 2-2 European Union Directives.

Applicable Standards/ Norms	
2004(2014)/108(30)/EC	Electromagnetic Compatibility Directive
2006/95/EC	Low Voltage Directive
2015/863/EU	RoHS Directive
EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements
EN 61000-6-4	Radiated Emissions Group 1, Class A
EN 61000-6-4	Conducted Emissions Group 1, Class A
EN 61000-6-2	Electrostatic Discharge Immunity
EN 61000-6-2	RF Electromagnetic Field Immunity
EN 61000-6-2	Electrical Fast Transient/Burst Immunity
EN 61000-6-2	Conducted RF Disturbances Immunity

After a laser or laser processing system has met the requirements of all applicable EU Directives, the product can bear the official compliance mark of the European Union as a Declaration of Conformity.

Declaration of Conformity

in accordance with ISO / IEC 17050-2:2004

We,

Manufacturer's Name: SYNRAD® A ©Novanta Company

Manufacturer's Address: 4600 Campus Place
Mukilteo, WA 98275 U.S.A.

Hereby declare under our sole responsibility that the following equipment:

Product Name: Firestar™ OEM vi30 Laser

Model Number: FSvi30SAC (*OEM)

Conforms to the following Directive(s) and Standard(s):

Applicable Directive(s):	2014/30/EU	Electromagnetic Compatibility Directive
	2014/35/EU	Low Voltage Directive
	(EU) 2015/863	RoHS Directive

Applicable Standard(s):

EN 61010-1:2010	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements
EN 61000-6-4:2007	Radiated Emissions, Group 1, Class A
EN 61000-6-4:2007	Conducted Emissions, Group 1, Class A
EN 61000-6-2:2005	Electrostatic Discharge Immunity
EN 61000-6-2:2005	RF Electronic Fields Immunity
EN 61000-6-2:2005	Electrical Fast Transient/Burst Immunity
EN 61000-6-2:2005	Conducted RF Disturbances Immunity

*OEM lasers do not comply with EN 60825-1:2014, *Safety of Laser Products*. Buyers of OEM laser products are solely responsible for meeting applicable Directives and Standards for CE compliance and marking.

Corporate Officer:

Tim Freni, Quality Manager of SYNRAD

Date: 7/22/19

European Contact:
Novanta Distribution (USD) GmbH
Parkring 57-59
85748 Garching bei München, Germany

CE

MADE IN THE U.S.A.
900-20976-16 Rev C

Figure 2-3 vi30 Document

Declaration of Conformity

in accordance with ISO / IEC 17050-2:2004

We,

Manufacturer's Name: SYNRAD® A ᴮNovanta Company

Manufacturer's Address: 4600 Campus Place
Mukilteo, WA 98275 U.S.A.

Hereby declare under our sole responsibility that the following equipment:

Product Name: Firestar™ OEM vi40 Laser

Model Number: FSvi40SAC (*OEM)

Conforms to the following Directive(s) and Standard(s):

Applicable Directive(s):	2014/30/EU	Electromagnetic Compatibility Directive
	2014/35/EU	Low Voltage Directive
	(EU) 2015/863	RoHS Directive

Applicable Standard(s):

EN 61010-1:2010	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements
EN 61000-6-4:2007	Radiated Emissions, Group 1, Class A
EN 61000-6-4:2007	Conducted Emissions, Group 1, Class A
EN 61000-6-2:2005	Electrostatic Discharge Immunity
EN 61000-6-2:2005	RF Electronic Fields Immunity
EN 61000-6-2:2005	Electrical Fast Transient/burst Immunity
EN 61000-6-2:2005	Conducted RF Disturbances Immunity

*OEM lasers do not comply with EN 60825-1:2014, *Safety of Laser Products*. Buyers of OEM laser products are solely responsible for meeting applicable Directives and Standards for CE compliance and marking.

Corporate Officer:

Glenn Gardner, President & GM of SYNRAD

Date: 7/22/19

European Contact:
Novanta Distribution (USD) GmbH
Parkring 57-59
85748 Garching bei München, Germany

CE

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Figure 2-4 vi40 Document

Operation

Use information in this section to familiarize yourself with laser controls and indicators and to begin operating the laser.

- Controls and indicators- displays and describes exterior controls and indicators on the OEM lasers.
- Initial start-up – Reference the appropriate Quick Start Guide on our Website to learn how to start your laser while verifying proper operation. synrad.com/synrad/docroot/resources/libraries/quickstart

Controls and Indicators

The controls and indicators section includes subsections.

- OEM vi30/40 front panel
- OEM vi30/40 rear panel

Warning: Serious Personal Injury

Any Class 4 CO2 laser product that emits invisible infrared laser radiation in the 9–11 μm wavelength band can seriously burn human tissue.

Because direct or diffuse laser radiation can inflict severe corneal injuries, always wear eye protection when in the same area as an exposed laser beam.

Do not allow the laser beam to contact a person.

Always be aware of the beam's path and always use a beam block while testing.

OEM vi30/40 front panel

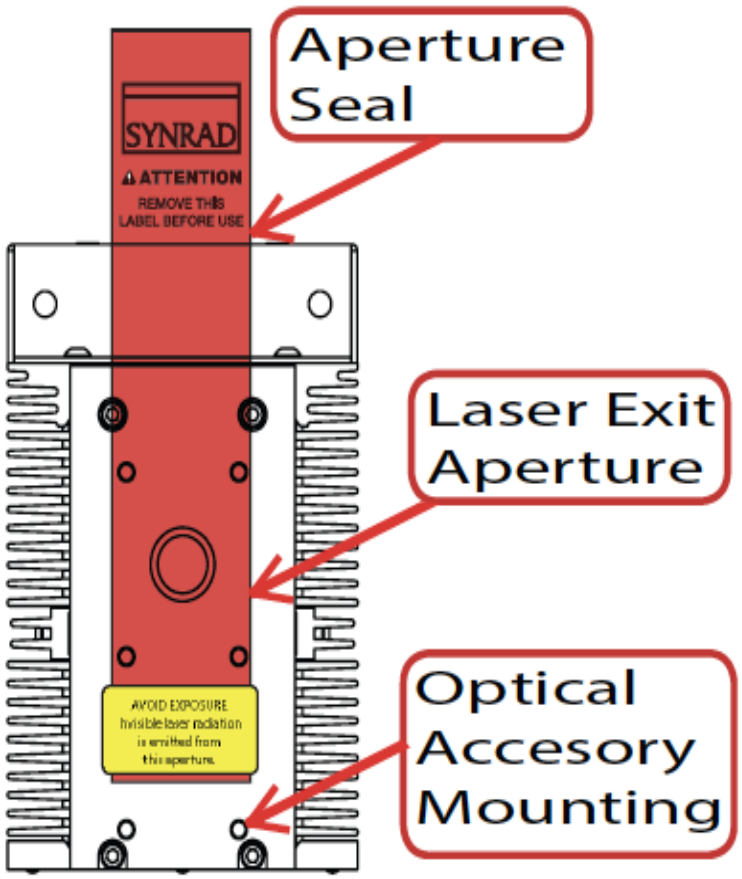


Figure 3-1 OEM vi30/40 Front panel controls and indicators.

Aperture Seal – prevents dust from damaging laser optics during shipping. Remove the red self-adhesive label before applying power to the laser.

Laser Aperture – provides an opening in the vi30/40's front panel from which the beam exits.

Optical Accessories Mounting – provides six threaded holes (8–32 UNC) for mounting optional beam delivery components. Because excessive weight may damage the laser, consult NOVANTA before mounting components not specifically designed as options. Refer to the OEM vi30/40 package outline drawings in the Technical Reference section for mounting dimensions

OEM vi30/40 rear panel

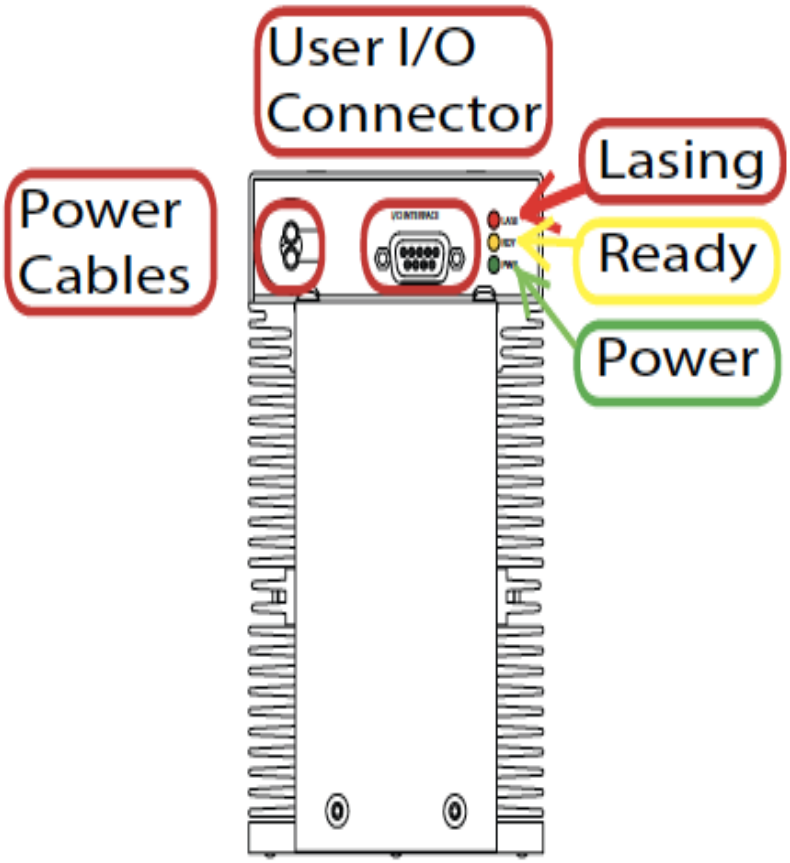


Figure 3-2 OEM vi30/40 Rear panel controls and indicators.

DC Power Cables – receives +48 VDC from the DC power supply. The DC power cables are manufactured from #12 AWG wire and measure 1 meter (42 inches) in length. The red (positive) cable contains a replaceable in-line fuse. If vi30/40 fuse replacement is required, refer to the Getting Started section of this manual.

DB-9 I/O Connector – provides a connection point for auxiliary output power as well as input and output signals. Refer to DB-9 I/O connections in the Technical Reference chapter for pinouts and signal descriptions.

LASE Indicator – illuminates red to indicate that the laser is actively lasing. The LASE indicator is off when tickle pulses are being generated and illuminates red when PWM Com-mand signal pulses are long enough to produce laser output.

RDY (Ready) Indicator – illuminates yellow when the laser is enabled, indicating that, after an initial five-second delay, lasing will begin when a PWM Command signal is applied.

PWR (Power) Indicator – illuminates green when +48 VDC power is applied to the laser.

Important note: To prevent damage when mounting optical components to the OEM vi30 laser, the 8–32 UNC fasteners must extend no further than 4.8 mm (0.19") into the laser's faceplate.

Technical reference

Use information in this section as a technical reference for your laser

This section contains the following information:

- **Technical overview** – briefly describes vi30/40 technology and basic optical setup.
- **Controlling laser power** – explains various aspects of OEM vi30/40 control signals.
- **DB-9 I/O (Input/Output) connections** – describes signals and specifications for the OEM vi30/40's DB-9 I/O connector.
- **Vi30/40 general specifications** – provides specifications for OEM vi30/40 laser.
- **Vi30/40 outline and mounting drawings** – illustrates laser package outline and mounting dimensions for vi30/40 lasers.
- **Vi30/40 packaging instructions** – illustrates how to package vi30/40 lasers for shipment.
- **OEM vi30/40 packaging instructions** – illustrates how to package vi30/40 lasers for shipment using NOVANTA-supplied packaging materials.

Warning: Serious Personal Injury

The long 9-11 µm wavelength of CO2 lasers is easily reflected or scattered off metallic surfaces which can lead to personnel injury and/or damage to equipment.

Enclose the processing area in an interlocked enclosure and ensure proper safety glasses are worn. Use an optical isolator to protect the laser from damage.

Technical overview

The Technical overview section includes subsections:

- Laser design
- Optical setup

OEM vi30/40 design

Laser Tube

OEM vi30/40 lasers were developed using modern technology patented by NOVANTA, Inc. This patented "v" technology, based on a combination of free-space and waveguide resonator designs, enables NOVANTA to economically produce a symmetrical laser beam from a small but powerful laser capable of operating for many years with no maintenance. OEM vi30/40 unique extruded aluminum envelope offers excellent heat transfer, long gas life, and low operating costs in contrast to other laser tube technologies. In addition to being the vessel that maintains the lasing environment, the aluminum tube is also the structural platform that integrates the laser's optical, electrical, and cooling components.

Caution: Possible Equipment Damage

Because of their smaller beam diameter, vi30 lasers have significantly higher power densities than previous NOVANTA lasers. This means that even a small amount of contamination on the laser's output window (or on any optic in the beam path) can absorb enough energy to damage the optic. Inspect the output window and other beam delivery optics periodically for signs of contaminants and carefully clean as required. In dirty environments, purge laser optics using filtered air or nitrogen to prevent vapor and debris from accumulating on optical surfaces.

Optical resonator

The optical resonator, in conjunction with the electrodes and the gas mixture, generates the laser beam. vi30/40 optical resonators are comprised of four optical elements: a rear mirror, two turning mirrors, and an output window. These optical elements are fastened to the tube's exterior and are exposed to its interior through holes in the end caps. O-rings sandwiched between optical elements and each end cap form a gas seal and provide a flexible cushion that allows the slight movement necessary for alignment. All optical elements are aligned and locked into place by factory technicians before the laser is shipped.

The output beam, roughly circular as it exits the resonator, transitions to a Gaussian-like mode in mid and far fields—three meters (9.8 ft) and beyond. The internal structure and optics of the resonator combine to produce a Gaussian-like mode quality (M2 factor) of < 1.2. As shown in the following figure, beam waist diameter is 2.5 mm ±0.5 mm at the output aperture and full angle divergence due to diffraction is less than 7 milliradians (a 7 mrad full angle divergence means that beam diameter increases 7 mm over every one-meter distance traveled).

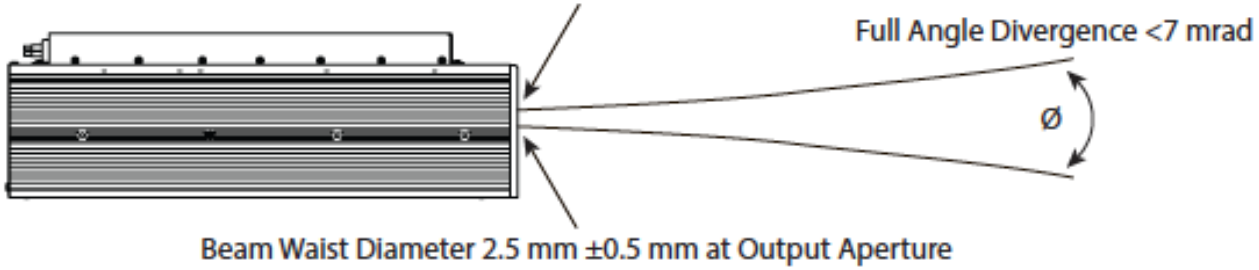


Figure 4-1 vi30/40 beam ellipticity.

Internal RF power supply

OEM vi30/40 lasers are driven by a compact radio frequency (RF) oscillator mounted in the laser chassis. The 48 VDC input voltage is converted into a high-power RF signal using an RF power oscillator. The output from the RF oscillator (nominally at 83.5 MHz) drives the laser directly by exciting carbon dioxide (CO2) gas in the tube to produce lasing.

Control circuit

Sensors built into the OEM vi30/40 control board monitor the laser for conditions like under/ over voltage, over temperature, and other faults that pose a risk of damage to the laser. The vi40 has temperature broadcasting capability. (See Appendix) Additionally, laser operation is controlled by a Laser Enable input.

Optical setup

After selecting a laser for a CO2 laser processing system, the two most crucial elements to consider are: (1) beam delivery optics to transmit the beam to the work area; and (2) focusing optics to focus the beam onto the part or material to be processed. Each element is crucial in the development of a reliable laser-based material processing system and each element should be approached with the same careful attention to detail.

Beam delivery optics

Divergence, or expansion, of the laser beam is important in materials processing since a larger beam entering the focusing optic produces a smaller focused spot. Because the vi30/40 laser beam diverges by 7 mm over each meter of distance traveled, the laser should be mounted a distance of 1.0–1.5 m (40–60 in) away from the work area and no closer than 0.75 m (30 in) for optimum performance. Right angle turning mirrors (beam benders) are often used in conjunction with the laser mounting position to obtain this distance.

Expander/collimators are optical devices that increase beam diameter by a selectable magnification factor while reducing beam divergence at the same time. Adding an expander/collimator reduces beam divergence and any variance in beam diameter caused by the changing optical path length in an XY ("flying optics") table application. In fixed-length delivery systems where the laser is positioned only one meter away from the focusing optic and a small spot size is required, an expander/collimator is again the best solution to provide the required beam expansion before reaching the focusing optic.

Focusing optics

When selecting a focusing optic, the primary consideration should be material thickness and any vertical tolerances that occur during final part positioning rather than selecting based only on minimum spot size. The chosen focal length should create the smallest possible focused spot while providing the depth of field required for the material being processed.

Optics are fragile and must be handled carefully, preferably by the mounting ring only. Be careful to select optics that are thick enough to withstand the maximum assist gas pressure available for the process. This is especially important in metal cutting applications using high-pressure assist gases.

Cleanliness is another principal issue affecting performance and becomes increasingly important as laser power increases. Dirty or scratched lenses will underperform, exhibit a vastly shortened lifetime, and may fail catastrophically.

When the application requires air (instead of nitrogen) as an assist gas, use only breathing quality air available in cylinders from a welding supply company. Compressed shop air contains minute particles of oil and other contaminants that will damage optical surfaces. If compressed shop air is the only choice available, it must be filtered and dried to ISO 8573-1:2010 Class 1, 2, 1 specification as shown in the following table.

Important Note: Optical components in the beam path must always be aligned to the actual beam path, not the laser faceplate. Because of slight variations in laser construction, the beam path may not always be centered in, or perpendicular to, the aperture in the faceplate.

Table 4-1 Assist gas purity specifications

Assist Gas	Typical Purpose	Specification	
Air	Cutting/Drilling	Breathing Grade	> 99.9996% purity; filtered to ISO Class 1 Particulate leverl
Air	Cutting/Drilling	Compressed	Instrument-grade air filtered and dried to ISO 8573-1:2010 Class 1, 2, 1 (< 10 1.0â€ "5.0 Âµm particles/m3; < â€ "40 Â°F dew point; < 0.01 mg/m3 oil vapor)
Argon	Welding	High Purity Grade	> 99.998% purity; filtered to ISO Class 1 particulate level

Helium	Welding	High Purity Grade	> 99.997% purity; filtered to ISO Class 1 particulate level
Nitrogen	Cutting/Drilling	High Purity Grade	> 99.9500% purity; filtered to ISO Class 1 particulate level
Oxygen	Cutting/Drilling	Ultra-pure Grade	> 99.9998% purity; filtered to ISO Class 1 particulate level

Cooling

Heat generated by excited CO2 molecules is transferred to the bore walls and cooling fins by diffusion. For air cooled versions, dual side fans, or rear fan prevent the laser from overheating. Further heat can also be transferred to water through external corrosion-resistant copper alloy tubing to regulate temperature for maximum stability.

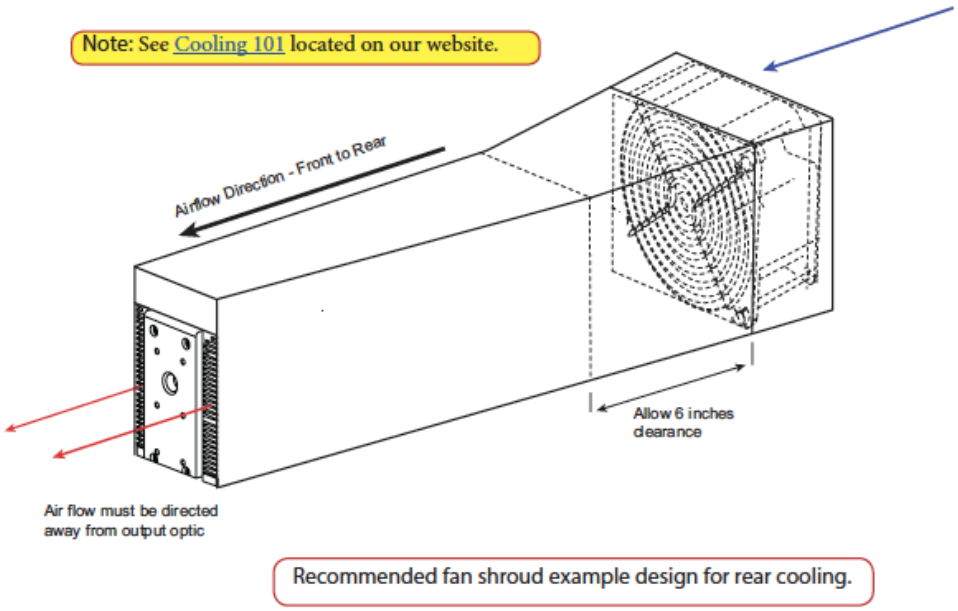


Figure4.2Recommended fan shroud example

Cooling by fan or air

Because vi30/40 lasers are OEM products, they do not include cooling fans. Customers must provide some type of air cooling to prevent the laser from overheating. NOVANTA recommends using two cooling fans rated for at least 4.0 m3/min (140 CFM) for the vi30, or 5.4m3/min (190) for the vi40. The cooling fans should measure 120 × 120 mm (4.7” × 4.7”) and have at least 57.2 mm (2.25”) of unobstructed clearance between the rear face of the fan housing and any mounting surface or enclosure.

For free-space mounting (no fan shroud), position the fans symmetrically, as shown in the following figure, where they are centered horizontally with the laser chassis and vertically with the heat-sink fins. Position both fans so the front face is no more than 76mm (3.0") from the vi30/40's heat-sink fins.

When using a tight-fitting fan shroud designed for side cooling, the cooling fans can be positioned within 5–25 mm (0.20–1.0") of the heatsink fins as long as the same gap is maintained on either side.

A fan shroud designed for rear cooling can be used to minimize the width of the laser installation as shown in the figure below. The shroud should enclose the full length of the laser and the cooling fan and must fit snugly against the laser's heat-sink fins. Use a fan rated for at least 8.5 m3/min (300 CFM) at a static air pressure of 23.9 mm H2O (0.94 in H2O) and position it approximately 150 mm (6.0") from the rear of the laser.

The OEM vi30/40 does not provide a voltage output sufficient to power cooling fans, so customers must provide an external power source to drive the selected cooling fans. Because of the heat generated by internal RF circuitry, establishing significant airflow evenly over the entire surface of the combined laser/RF chassis is vitally important to the performance and longevity of the laser.

Caution: Possible Equipment Damage

Customer designed fan shroud must enclose both the OEM laser and cooling fan

Temperature monitoring

For customers who wish to monitor vi30 chassis temperature, the vi30 Fan Cooled Laser Quick Start Guide shows the recommended location for mounting a customer-supplied external temperature sensor. A chassis reading of approximately 70 °C (158 °F) for the vi30 will start to trigger over-temperature faults. The vi40 has on-board monitoring and a reading of 70 °C (158 °F) will start to trigger over-temperature faults.

Flow rate

Ensure that coolant flow is 1.0 GPM (3.8 LPM), and the pressure does not exceed 60 PSI (4.1 bar).

Setting coolant temperature

Choosing the correct coolant temperature is important to the proper operation and longevity of your laser. When coolant temperature is lower than the dew point (the temperature at which moisture condenses out of the surrounding air), condensation forms inside the laser housing leading to failure of laser electronics as well as damage to optical surfaces.

The greatest risk of condensation damage occurs when the laser is in a high heat/high humidity environment and the chiller's coolant temperature is colder than the dew point of the surrounding air or

when the system is shut down, but coolant continues to flow through the laser for extended periods of time.

The chiller's temperature set-point must always be set above the dew point temperature. In cases where this is not possible within the specified coolant temperature range of 18 °C to 22 °C (64 °F to 72 °F), then the following steps MUST be taken to reduce the risk of condensation damage.

Guidelines

- Air-condition the room or the enclosure containing the laser.
- Install a dehumidifier to reduce the humidity of the enclosure containing the laser.
- Stop coolant flow when the laser is shut down.
- Increase coolant flow by an additional 1.0 GPM. Do not exceed a coolant pressure of 414 kPa 60 PSI.

See dew point temperature table at the end of this section for a range of air temperature and relative humidity values. Remember that the laser's coolant temperature must be set above the dew point temperatures shown in the chart but should not exceed 22 °C (72 °F).

Table 4-2 Dew Point Table °F temperatures.

Dew Point Table °F

Air Temp (°F)	Relative Humidity (%)															
	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
60 °F	-	-	-	32	36	39	41	44	46	48	50	52	54	55	57	59
65 °F	-	-	33	37	40	43	46	48	51	53	55	57	59	60	62	64
70 °F	-	33	37	41	45	48	51	53	56	58	60	62	64	65	67	69
75 °F	-	37	42	46	49	52	55	58	60	62	65	67	68	70	72	73
80 °F	35	41	46	50	54	57	60	62	65	67	69	71	73	75	77	78
85 °F	40	45	50	54	58	61	64	67	70	72	74	76	78	80	82	83
90 °F	44	50	54	59	62	66	69	72	74	77	79	81	83	85	87	88
95 °F	48	54	59	63	67	70	73	76	79	81	84	86	88	90	92	93
100 °F	52	58	63	68	71	75	78	81	84	86	88	91	93	95	97	98

Table 4-3 Dew Point Table °C temperatures (continued)

Dew Point Table °C

Air Temp (°C)	Relative Humidity (%)															
	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
16 °C	-	-	-	0	2	4	5	7	8	9	10	11	12	13	14	15
18 °C	-	-	1	3	4	6	8	9	11	12	13	14	15	16	17	18
21 °C	-	1	3	5	7	9	11	12	13	14	16	17	18	18	19	21
24 °C	-	3	6	8	9	11	13	14	16	17	18	19	20	21	22	23
27 °C	2	5	8	10	12	14	16	17	18	19	21	22	23	24	25	26
29 °C	4	7	10	12	14	16	18	19	21	22	23	24	26	27	28	28
32 °C	7	10	12	15	17	19	21	22	23	25	26	27	28	29	31	31
35 °C	9	12	15	17	19	21	23	24	26	27	29	30	31	32	33	34
38 °C	11	14	17	20	22	24	26	27	29	30	31	33	34	35	36	37

Controlling laser power

The Controlling laser power section includes subsections:

- Control signals
- Operating modes

Control signals

Much of the information provided in this section describes the use of a NOVANTA UC-2000 Universal Laser Controller to provide tickle and PWM Command signals to the vi30/40 laser. If using an alternate method of laser control, thoroughly review this section, controlling laser power, as well as the following section, DB-9 I/O connections, for an understanding of the signal requirements necessary to control

lasers. For more information about the UC- 2000, please consult the UC-2000 Laser Controller Operator's Manual.

Operating Modes

Tickle pulse

Tickle pulses pre-ionize the laser gas to just below the lasing threshold so that a further increase in pulse width adds enough energy to the plasma to cause laser emission. Tickle pulses cause the laser to respond predictably and instantaneously to PWM Command signals, even when there is considerable delay (laser off time) between applied Command signals.

OEM vi30/40 lasers do not incorporate internal tickle; therefore, users must provide 1µs duration tickle pulses, at a frequency of 5 kHz, between applied PWM Command signals. A tickle pulse must be sent at the end of every 200-µs interval in which a PWM Command signal was not applied.

Pulse Width Modulation (PWM)

Pulse Width Modulation, or PWM, controls laser power by varying the duty cycle of the laser's RF amplifiers, which in turn control the time averaged RF power applied to the laser. Typically, laser output follows the PWM input with a rise and fall time constant of ~100 µs; however, the laser cannot precisely follow PWM input signals if the "On" pulse is less than 100 µs in duration. At a constant 50% duty cycle, vi30/40 lasers typically reach 90–100% of full optical output when operated at a frequency of 5 kHz and reach 65–80% optical output at 7 kHz. The percentage of optical output increases as duty cycle increases (at a constant PWM frequency) or as PWM frequency decreases (at a constant duty cycle). The following figure shows representative vi30/40 optical output waveforms at two different PWM frequencies.

OEM vi30/40 lasers are designed to operate at Command signal base frequencies up to 100 kHz; however, the choice of PWM frequency depends on the user's specific application. In many laser applications, the UC-2000's default Command signal frequency of 5 kHz has proven to work well. For high-speed motion applications that cannot tolerate any ripple in the optical beam response but still need adjustable power levels, we recommend the use of higher PWM frequencies, up to 100 kHz maximum.

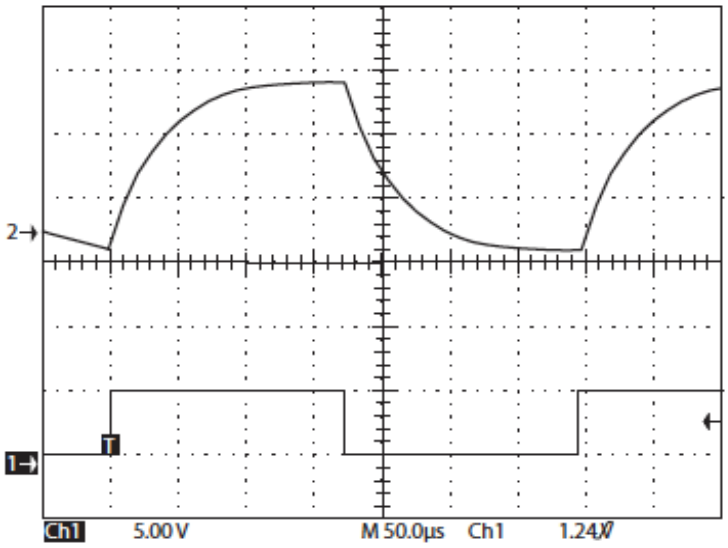


Figure 4-3 Typical optical output pulse (50%) duty cycle at 3kHz.

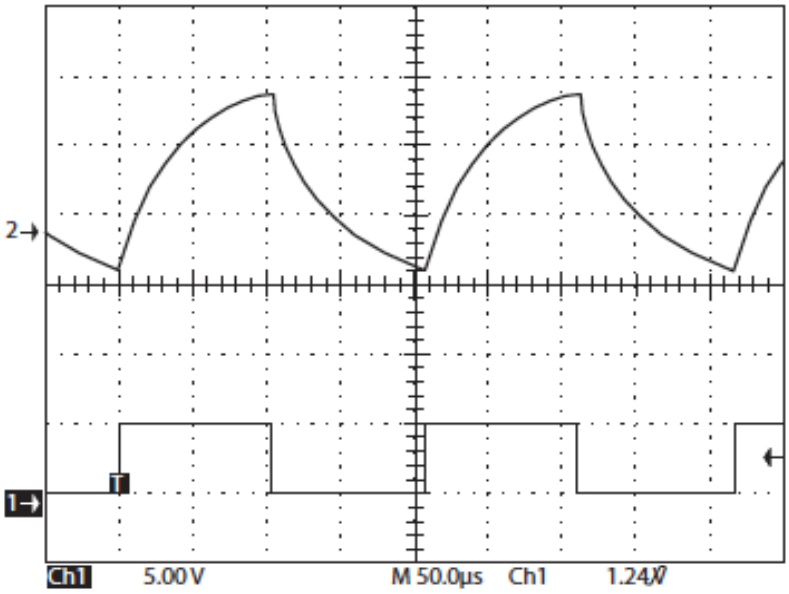


Figure 4-4 Typical optical output pulse (50%) duty cycle at 5kHz.

Warning: Serious Personal Injury

Always use shielded cable when connecting your PWM Command signal source to PWM Positive/PWM Negative inputs. In electrically-noisy environments, long lengths of unshielded wire act like an antenna and may generate enough voltage to trigger uncommand lasing.

Command signal

The modulated Command signal applied between Pin 1, PWM Positive, and Pin 6, PWM Negative, on either interface connector has three basic parameters: signal amplitude, base frequency, and PWM duty cycle. By changing these parameters, you can command the beam to perform a variety of marking, cutting, welding, or drilling operations.

The first Command signal parameter, signal amplitude, is a square wave that is either logic low—corresponding to laser beam off, or logic high—corresponding to beam on. The laser off voltage, typically 0 V, can range from 0.0 V to +0.8 VDC while the laser on voltage, typically 5 V, can range from +3.5 V to +6.7 VDC.

Base frequency, the second parameter, is the repetition rate of the PWM input signal. The standard base frequency is 5 kHz, which has a period of 200 µs. Maximum PWM frequency is 100 kHz.

The third Command signal parameter, PWM duty cycle, is the percentage of the period that the Command signal is high. If the Command signal's amplitude (at 5 kHz) is high for 100 µs and low for 100 µs, it has a 50% duty cycle; if the amplitude is high for 190 µs and low for 10 µs, it has a 95% duty cycle. The following figure illustrates PWM Command signal parameters while the following table lists PWM signal specifications

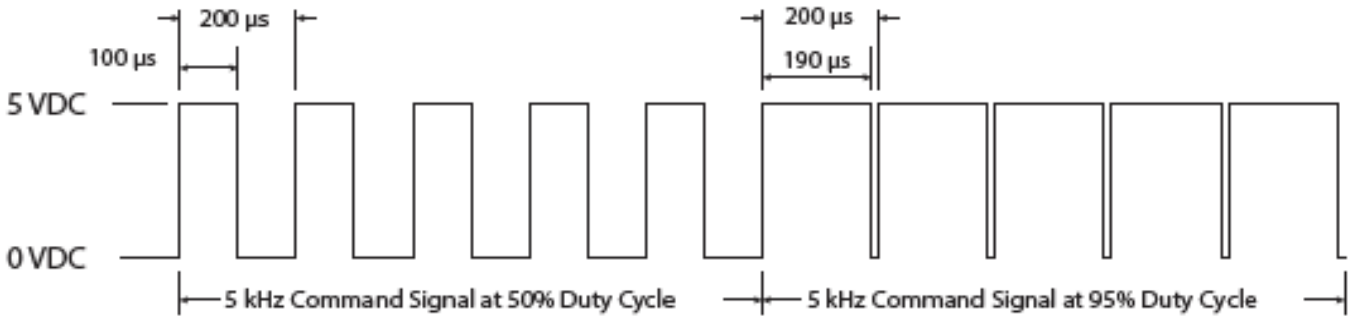


Figure 4-5 PWM Command signal waveform

The vi30/40's DB-9 I/O PWM input consists of a high-speed optoisolator LED with a forward voltage drop (Vf) of 1.5 VDC. The PWM input frequency can range from DC (0 Hz) to 100 kHz. The following table below provides minimum, maximum, and nominal PWM signal specifications.

Table 4-4 PWM Command signal levels

Laser State	Minimum	Nominal	Maximum
Laser Off	0.0 VDC	0.0 VDC	+0.8 VDC
Laser On	+3.5 VDC (5 mA)	+5.0 VDC (9 mA)	+6.7 VDC (10 mA), continuous
Frequency Range	0 Hz (DC)	5 kHz	100 kHz
Duty Cycle	0%	— —	100%

Important Note: NOVANTA lasers are designed for maximum performance at a 95% duty cycle. Increasing the maximum PWM percentage beyond 95% increases the laser's heat load with little or no corresponding increase in laser output power.

The vi30/40's DB-9 I/O PWM input consists of a high-speed optoisolator LED with a forward voltage drop (Vf) of 1.5 VDC. The PWM input frequency can range from DC (0 Hz) to 100 kHz. The prior PWM command signal level table provides minimum, maximum, and nominal PWM signal specifications.

External control

In addition to controlling the OEM vi30/40 laser using a UC-2000 Universal Laser Controller, control of laser externally, without a UC-2000, is also possible. The two primary elements of laser control are gating, the ability to turn the laser on and off at the appropriate times, and power, the ability to control the laser's output energy. Both gating and power can be handled by a device such as a personal computer, Programmable Logic Controller (PLC), or function generator capable of providing tickle pulses in addition to sending PWM signals at the proper time (gating) and with the proper duty cycle (power).

Analog voltage or current control

Although OEM vi30/40 lasers cannot be controlled directly by analog voltage or current signals, this type of control is possible when using the UC-2000 Controller. The Controller is connected normally to the laser and analog voltage, or current signals sent to the UC-2000's ANV/C connector then control both laser gating and power.

To generate the correct analog voltage for the UC-2000 Controller from a computer or PLC, a Digital-to-Analog (D/A or DAC) card capable of generating 0 V (laser off) to 10 V (maximum laser power) must be installed. To generate the proper analog current, install a D/A card that can generate 4 mA (laser off) to 20 mA (maximum power). Software able to control your analog output card is required for either configuration.

Continuous wave (CW)

In some applications, such as high-speed marking or cutting, the time constant of the laser and the PWM modulation causes a series of dots that may be visible on the marking surface instead of a “clean” line. Operating the laser in CW mode will prevent this behavior from occurring.

To operate the laser in CW mode, apply a constant +5 VDC signal to Pin 1, PWM Positive, and Pin 6, PWM Negative, on the DB-9 I/O connector. This constant voltage source forces the internal switching electronics to remain on, providing continuous and uninterrupted laser output power. During CW operation, output power cannot be changed. To adjust output power, refer to the Pulse Width Modulation (PWM) section for information regarding high frequency operation.

Warning: Serious Personal Injury

The UC-2000’s default gate logic is factory set to internal Pull-Up (normally on) mode so that an open (disconnected) Gate input causes the laser to turn on. This functionality allows the user to easily test and verify laser operation prior to integration.

In an integrated system, you should configure the UC-2000’s gate input logic to internal Pull-Down (normally off) mode. This prevents the beam from being enabled unless a high level (+3.5 V to +5.0 VDC) signal is applied to the Gate input connector. In the Pull- Down (normally off) mode an asserted logic low signal, short circuit to ground, or an open or disconnected Gate inputs locks the beam off.

Gated operation

In many marking and cutting applications, the laser is required to pulse, or gate, on and off in synchronization with an external control signal (typically from a computer or function generator operating in the range from DC to 1 kHz). To pulse or gate the laser, connect a signal providing +5.0 VDC pulses to the Gate connector on the rear panel of the UC-2000.

Users who intend to use a gating signal should set the UC-2000’s gate input logic to internal Pull-Down (normally off) mode. This prevents the beam from being enabled unless a high level (+3.5 V to +5.0 VDC) signal is applied to the Gate input connector. In the pull-down (normally off) mode, an asserted logic low signal, short circuit to ground, or an open or disconnected Gate input locks the beam off.

Many CO_2 lasers operating in applications requiring short gating pulses at repetition rates below 500 Hz will exhibit some leading-edge overshoot regardless of the PWM frequency. This occurs because a cooler lasing medium (the CO_2 gas) is more efficient than a hotter one. The overshoot effect is more pronounced at lower gating frequencies since the gas has a longer time to cool down between Command signal pulses.

User I/O connection summary

The User I/O connections section includes subsections:

- Input circuitry
- Output circuitry

DB-9 I/O connections

The DB-9 I/O connector provides a +5 VDC auxiliary output (DC Out), a PWM input, an enable input, and four status outputs. The user inputs, Laser Enable and PWM Positive/PWM Negative, enable lasing and provide output power control. User outputs indicate vi30/40 ready, lase, overtempt, and input voltage status. The OEM vi30/40's PWM inputs are optoisolated; however, all other inputs and outputs operate using standard 5V logic levels (0V – logic low; 5V – logic high). Both inputs and outputs are ESD protected but are not optoisolated; all input signals sent to the laser must be clean or conditioned by the user. The figure below illustrates the pin arrangement of the DB-9 I/O (9-pin female D-type subminiature) connector on the OEM vi30/40's rear panel while the following table provides connection descriptions.

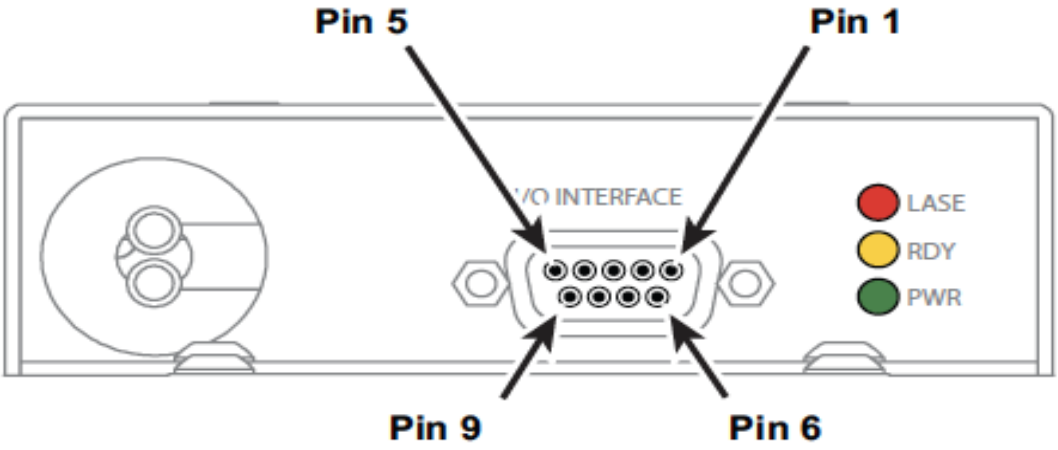


Figure 4-6 DB-9 I/O connector pinouts.

Table 4-5 DB-9 I/O pin descriptions

Pin	Description	Function
1	PWM Positive Input	Use this optoisolated voltage input for tickle and PWM signals referenced to PWM Negative (Pin 6). The tickle signal is a +5 VDC, 1 µs pulse at 5 kHz while the PWM Command signal is a +5 VDC, 5 kHz nominal (100 kHz max) pulse width modulated square wave.
2	Laser Ready output	This output is logic high (+5 V) when the laser is ready to lase (RDY indicator illuminated yellow). The output is low (0 V) when the laser is disabled (RDY indicator Off). The Laser Ready output sources 20 mA typical, 40 mA maximum.
3	Lase Indicator output	This output is logic high (+5 V) when the laser is actively lasing (LASE indicator illuminated red). The output is low (0 V) when the laser is not lasing (LASE indicator Off). The Lase Indicator output sources 20 mA typical, 40 mA maximum.
4	Overtemp Fault Output (vi30) Temperature Broadcast Signal (vi40)	On the vi30 laser, this output goes logic high (+5V) when an over temperature fault condition is detected, causing the RDY indicator to flash continuously. When the laser is operating within the normal temperature range, this output is at 0V. This output sources 20 mA typical, 40 mA maximum. On the vi40 laser, this output provides the Temperature Broadcast Signal. See Appendix A for full details.
5	DC Out output	This connection provides a +5 VDC, 250 mA maximum user output voltage referenced to GND (Pin 8). For example, this voltage can be jumpered, or switched, to drive the Laser Enable input.
6	PWM Negative input	This input provides the negative, or return, side of the optoisolated tickle/PWM Command signal referenced to PWM Positive (Pin 1).
7	DC Voltage Fault output	This output is logic high (+5 V) if the DC input voltage is under or over voltage limits (PWR indicator flashes a sequence of 2 blinks, pauses 1/2 second, and then repeats). The output is low (0 V), when DC input voltage is within limits. The DC Voltage Fault output sources 20 mA typical, 40 mA maximum.
8	GND	This connection is the ground, or return, point for all signals except PWM Positive.
9	Laser Enable input	When this input is logic high (+5 V), the laser is enabled (RDY indicator illuminates yellow). The laser is disabled when the input is low (0 V). After this input goes high, a five-second delay occurs before tickle or PWM signals are applied to the RF circuit.

Important Note: When switching +5 VDC to the Laser Enable input on Pin 9 through a switch or relay contact, we highly recommend adding a 100 Ohm, 1/4-watt resister in series between the switching device and the Laser Enable input.

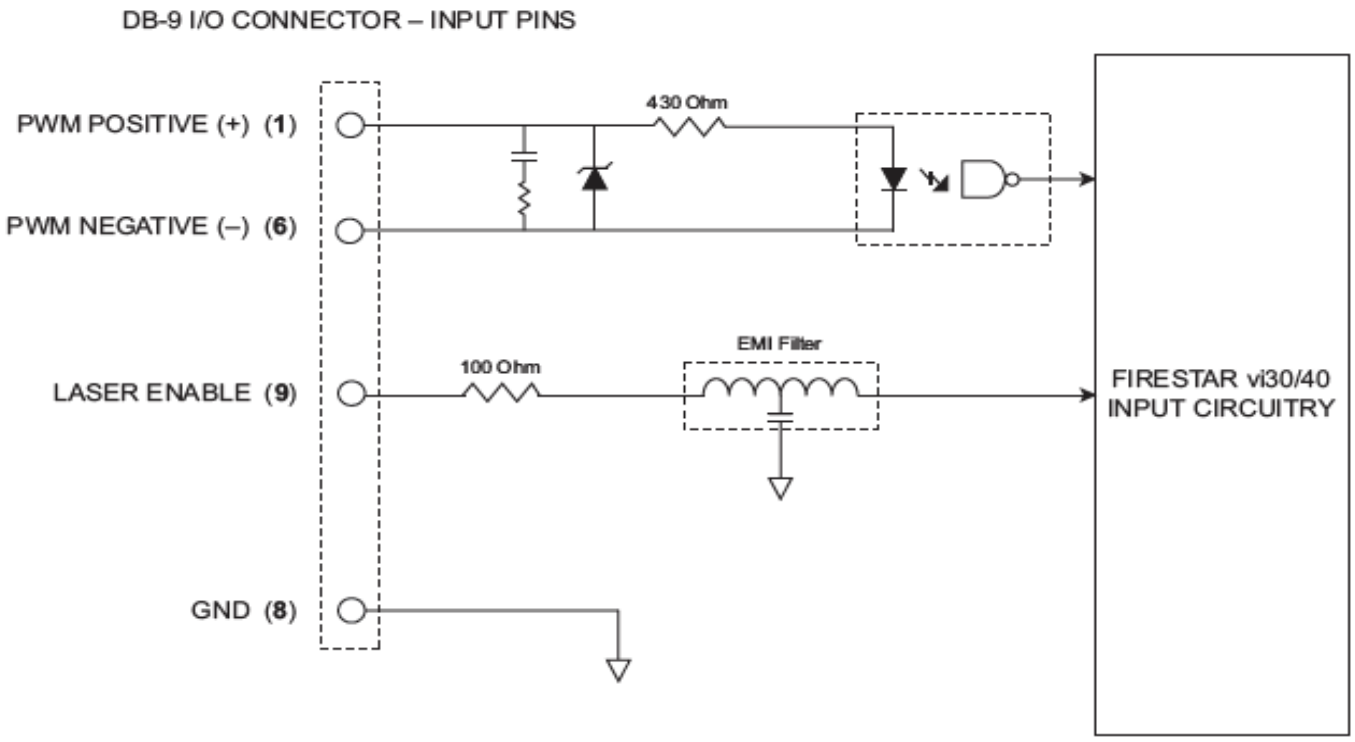


Figure 4-7 Input equivalent schematic.

Table 4-6 DB-9 input circuit specifications.

Input Signals	Input device type and specifications
PWM Positive Input	High-speed optoisolator LED, forward voltage drop (Vf) 1.5 VDC Off state Vmax +0.8 VDC On state Vmin +3.5 VDC @ 5 mA On state (continuous) Vmax +6.7 VDC @ 10 mA Frequency, max. 100 kHz
Laser Enable	5V logic input buffer Off state Vmax +0.8 VDC On state Vmin +2.0 VDC @ 0.2 mA On state (continuous) Vmax +5.0 VDC @ 0.5 mA

Important Note: Do not apply a Laser Enable signal until the OEM vi30/40's internal +5 VDC power supply has stabilized (approximately 200 ms after DC power-up).

Sample input circuit

DB-9 I/O Connections

The figure below illustrates one method of applying the Laser Enable signal using a customer-supplied limit switch or relay contact powered by the OEM vi30/40's DC Out output (+5 V, 250 mA).

DB-9 I/O PINS

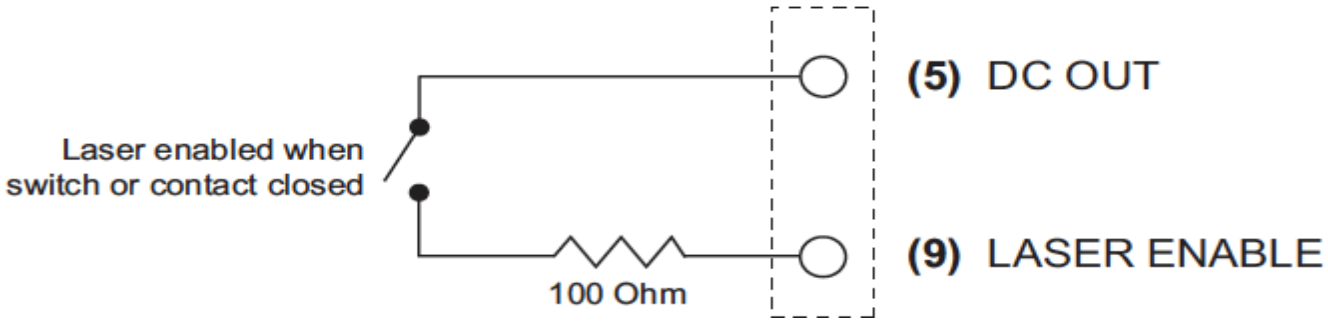


Figure 4-8 OEM vi30/40 powered Laser Enable circuit.

The following figure shows another variation for applying a Laser Enable signal. In this case, the customer is also supplying the voltage necessary to drive the vi30/40's enable circuit.

DB-9 I/O PINS

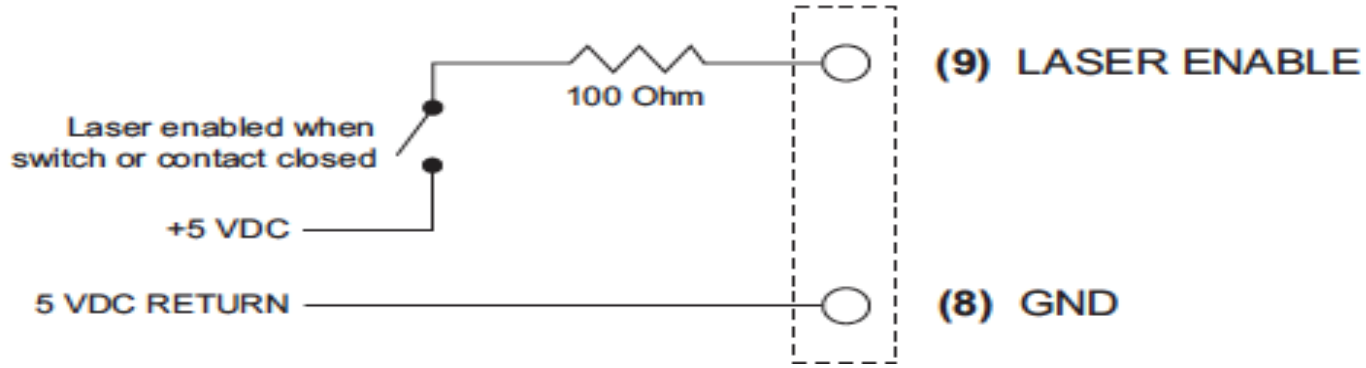


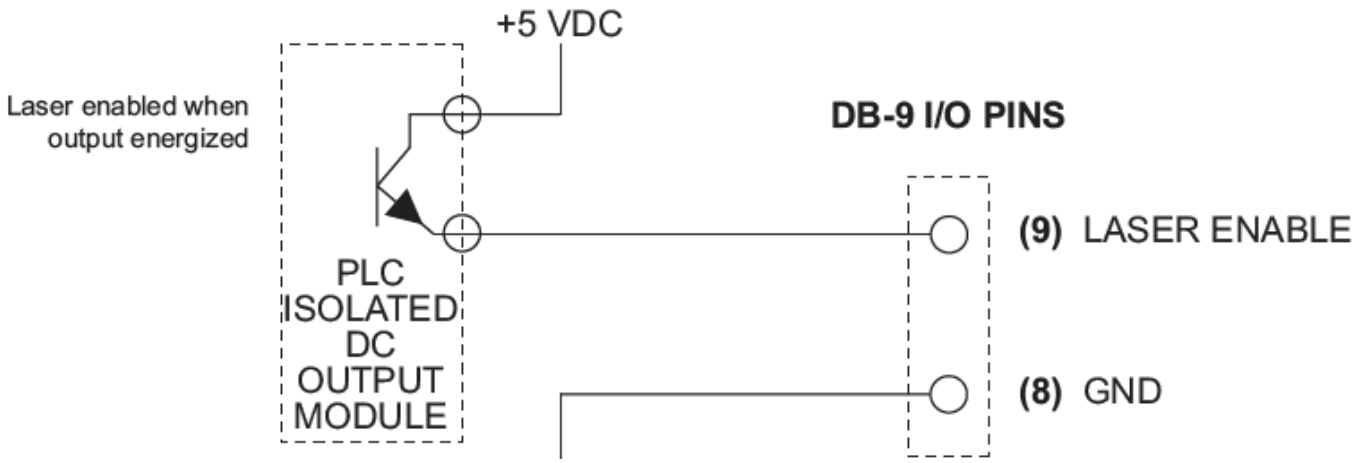
Figure 4-9 Customer powered laser enable circuit.

Caution: Possible Equipment Damage

The Laser Enable input is a direct 5V logic input. Do not send a voltage signal to the Laser Enable input (Pin 9) until DC power is applied; otherwise, the control board will be damaged.

Observe all 5V logic specifications and precautions when integrating OEM vi30/40 inputs and outputs into your control system.

The figure below shows an isolated PLC output module switching the Laser Enable signal from a +5 V



source.

Figure 4-10 PLC switched laser enable circuit.

Output circuitry

The OEM vi30/40 has four user outputs that communicate laser status to the user's control system. As described in the following table, the four outputs, Laser Ready, Lase Indicator, Overtemp Fault, and DC Voltage Fault are ESD protected, but are not optoisolated. The Laser Ready output goes high (+5V) when lasing is possible, otherwise the output is low (0V) when the laser is not ready. Lase Indicator goes high when the PWM signal is sufficient to induce laser output and is low when no beam is being emitted. Overtemp Fault goes high when laser temperature rises above its upper thermal limit; otherwise, the output is low. DC Voltage Fault goes high when an under/over voltage condition is sensed; otherwise, the output is low when the DC supply voltage is within limits.

The vi30/40 also includes a +5 VDC output voltage source, DC Out. This output can provide a maximum current of 250 mA and is useful for driving the Laser Enable input as described in the Input circuitry subsection.

The table below provides vi30/40 output circuit specifications while the figure on the following page illustrates the output circuit's equivalent internal schematic.

Important Note: OEM vi30/40 outputs are voltage sources. Each output can source only 20 mA typical, 40 mA maximum, to a ground referenced load (the ground reference, GND, is Pin 8). The control board will be damaged if this current limit is exceeded.

Output Signals	Output device type and specifications
Laser Ready	5V logic output buffer

Laser Enable	On state Vmin +4.5 VDC @ 50 mA
Over-temp Fault	On state (typical) +5.0 VDC @ 0.5 mA
DC voltage Fault	Off state Vmax +0.8 VDC

Table 4-7 DB-9 output circuit specifications

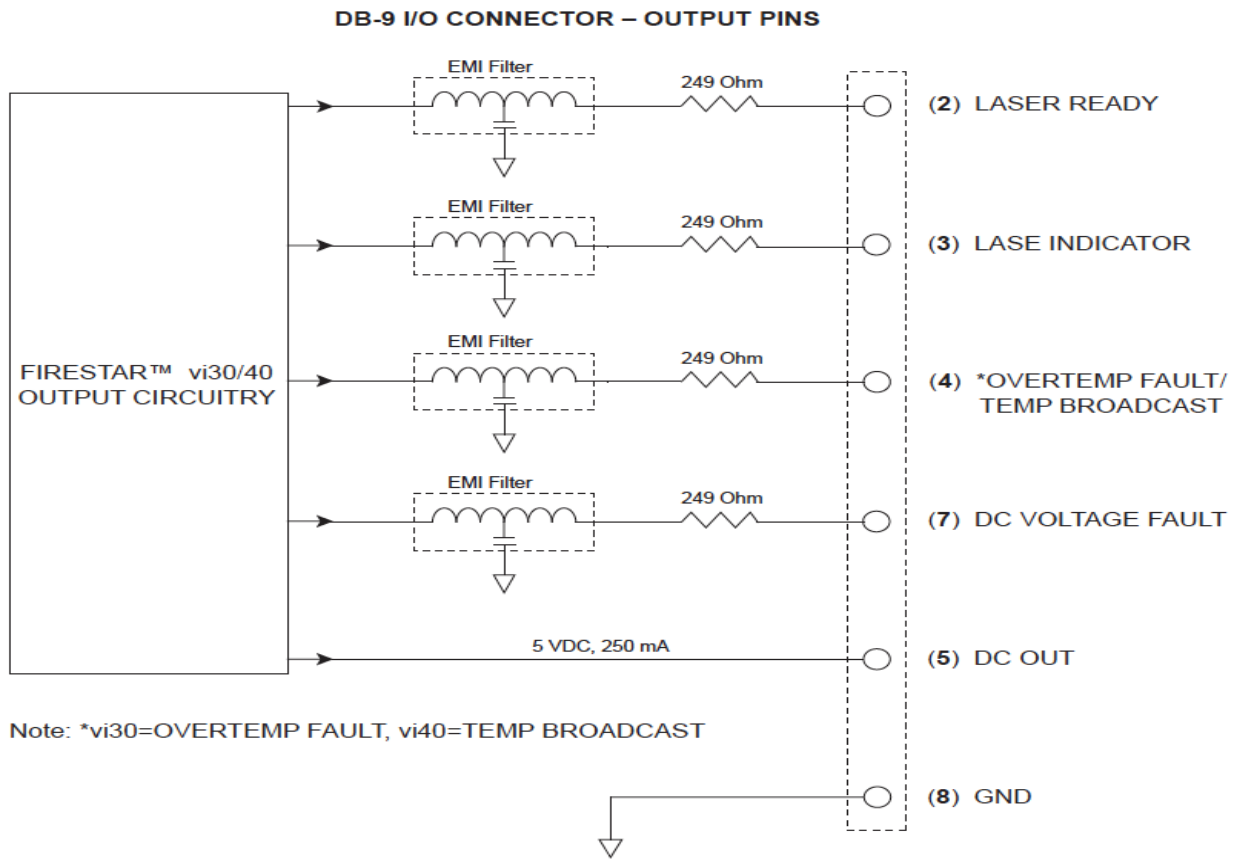


Figure 4-11 Output equivalent schematic.

Sample output circuit

You can monitor OEM vi30/40 laser status remotely by connecting one or more outputs to an isolated 5 VDC solid state relay or PLC input module. The figure below illustrates the connections required to monitor the vi30's Lase Indicator status, or any other vi30 output, using an isolated 5 VDC input module.

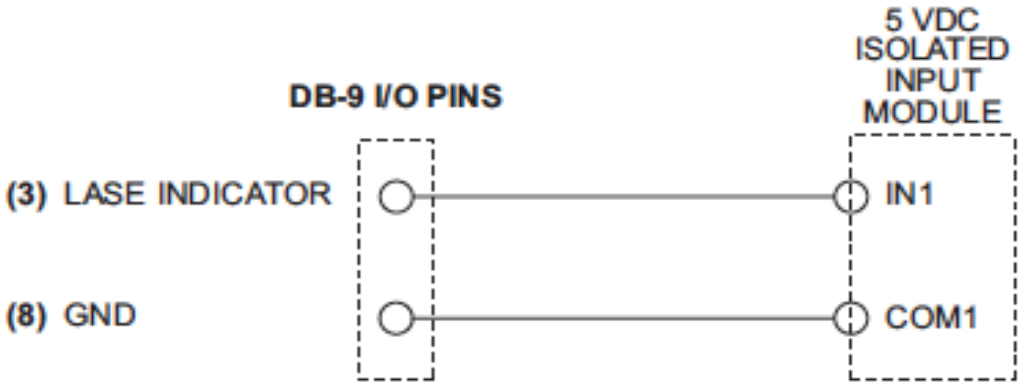


Figure 4-12 Lase indicator output to PLC input

Vi30/40 General Specifications

Table 4-8 vi30/40 General specifications.

Output Specifications	vi30 (9.3 µm)	vi30 (10.2 µm)	vi30 (10.6 µm)	vi40 (10.6 µm)
Wavelength typical (µm)	9.23-9.31	10.2-10.3	10.6 ± 0.03[9]	
Average Power Output continuous[2] (minimum)	20 W	25 W	30 W	40 W
Power Stability, guaranteed/after 2 min[3] (typ)	±7% / ±5%	±5% / ±3%		
Mode Quality M^2	≤ 1.2			
Beam Waist Diameter, mm (at $1/e^2$)	2.5 ±0.5			
Beam Divergence, full angle, mrad (at $1/e^2$)	< 7.0			
Ellipticity	< 1.2			
Polarization	Linear, horizontal			
Rise Time	<100 µs			

Input Specifications	vi30	vi40
Power Supply		
Voltage	48 VDC ± 2.0 VDC	
Maximum Current[5]	10A (11A peak for < 1ms)	15A (17A peak for < 1ms)
Input Signals	Tickle Signal / PWM Command Signal	
Voltage (5V nominal)	+3.5 to +6.7 VDC / +3.5 to +6.7 VDC	
Current	10 mA @ +6.7 VDC / 10 mA @ +6.7 VDC	
Frequency	5 kHz (1 µs duration) / DC-100kHz	

Cooling Specifications	vi30	vi40
Maximum Heat Load	500 Watts	680 watts
Maximum Chassis Temperature	vi30 70 °C (158 °F)	70 °C (158 °F)
Minimum Flow Rate	140 CFM per fan (two fans required)	190 CFM per fan (two fans required)

Environmental Specifications	vi30	vi40
Operating Ambient Temperature Range[4]	15 °C-40 °C	15 °C-45 °C
Humidity	0-95%, non-condensing	

General Specifications (Continued)

Table 4-8 vi30/40 General specifications (continued)

Physical Specifications	vi30 (dual)	vi30 (air)	vi40 (air)
Length	18.12 in (46.57 cm)	16.80 in (42.67 cm)	
Width	3.495 in (8.89 cm)[8]		
Height	5.46 in (13.87 cm) [6,7]		
Weight	15.00 lbs (6.80 kg)	14.30 lbs (6.49 kg)	14.80 lbs (6.71 kg)

** Specifications subject to change without notice.*

1 This power level is guaranteed for 12 months regardless of operating hours.

2 48 VDC input voltage to obtain guaranteed output power.

3 Guaranteed from cold start at 5kHz, 95% duty cycle. Value after 2 minutes typical.

4 Published specifications guaranteed at a temperature of 22 °C. Some performance degradations may occur in ambient temperatures above 22 °C. For air-cooled lasers, laser power typically decreases 0.5–1% per degree Celsius increase in ambient temperature.

5 For <1ms @ 100Hz, 50% duty cycle.

6 Mounting feet will add 1/4 in (0.64 cm) to overall height.

7 Tall models, add 1/4 in (0.64 cm) to overall height.

8 Wide models, add the width of the mounting feet for an overall width of 4.58 in (11.633 cm).

9 Typical. Actual wavelength may vary from 10.2 - 10.8 µm.

O&M Drawings

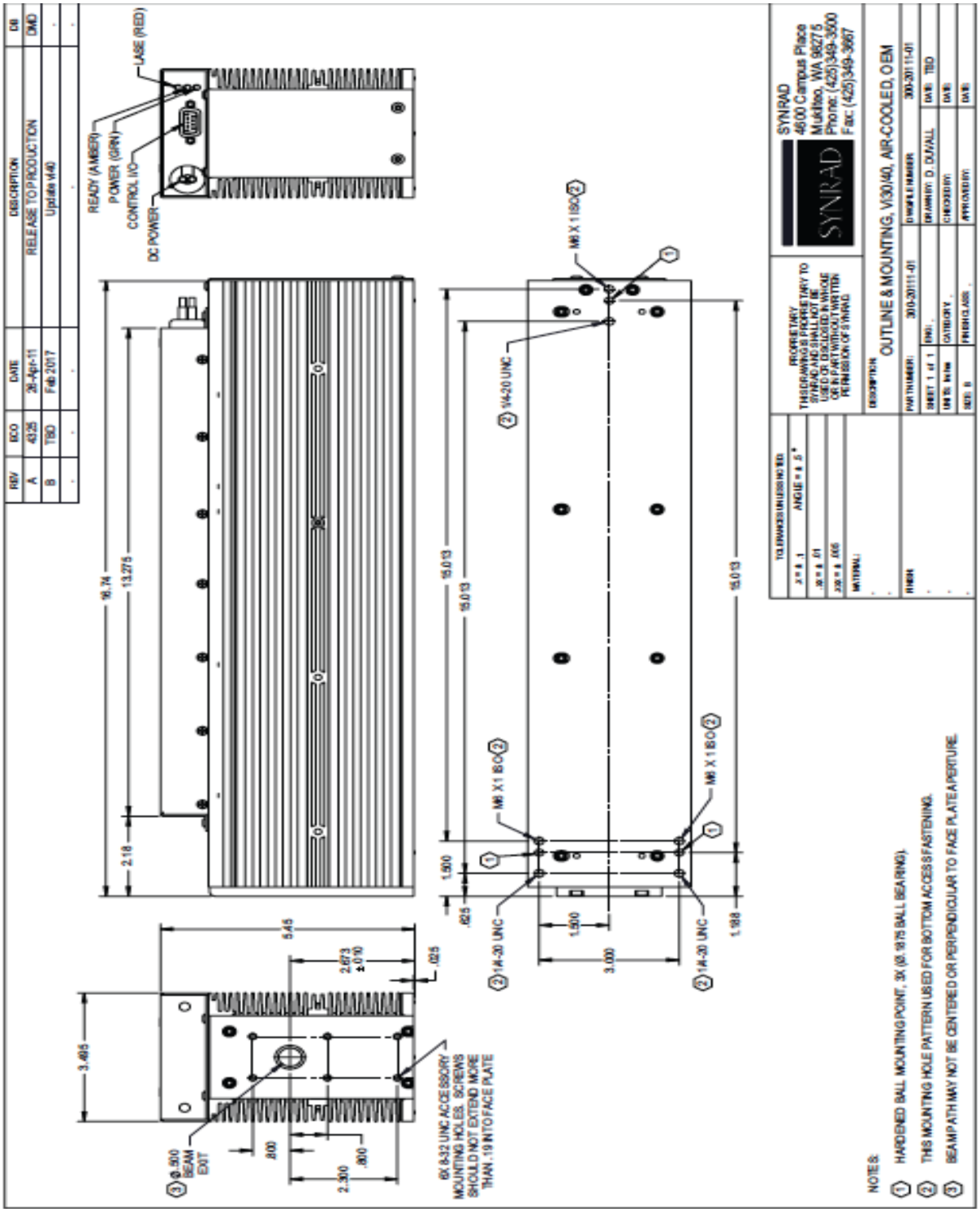


Figure 4-14 OEM vi40 standard package outline and mounting dimensions.

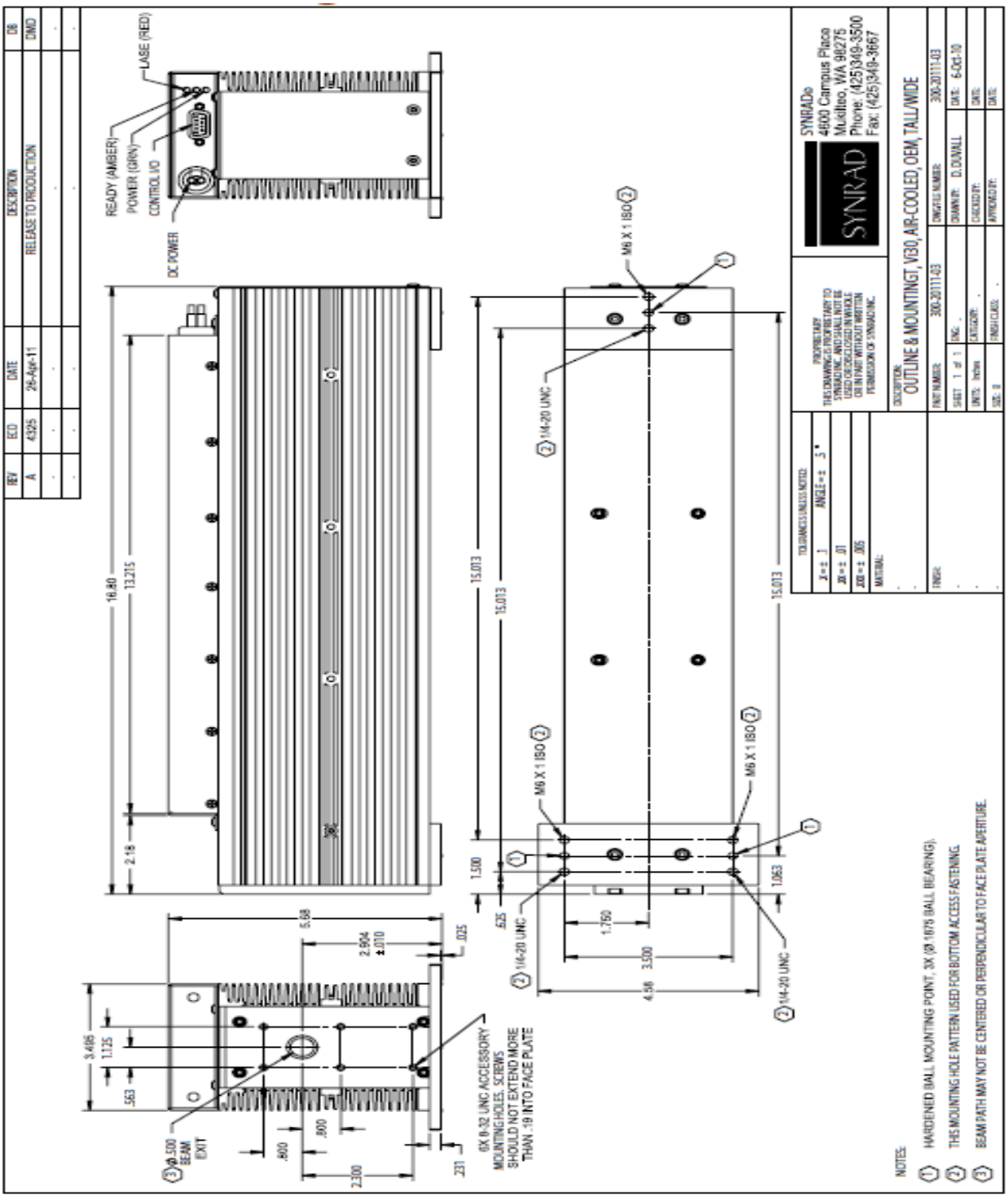


Figure 4-15 OEM vi30 package outline and mounting dimensions with optional customer-installed 'Tall/Wide' mounting feet.

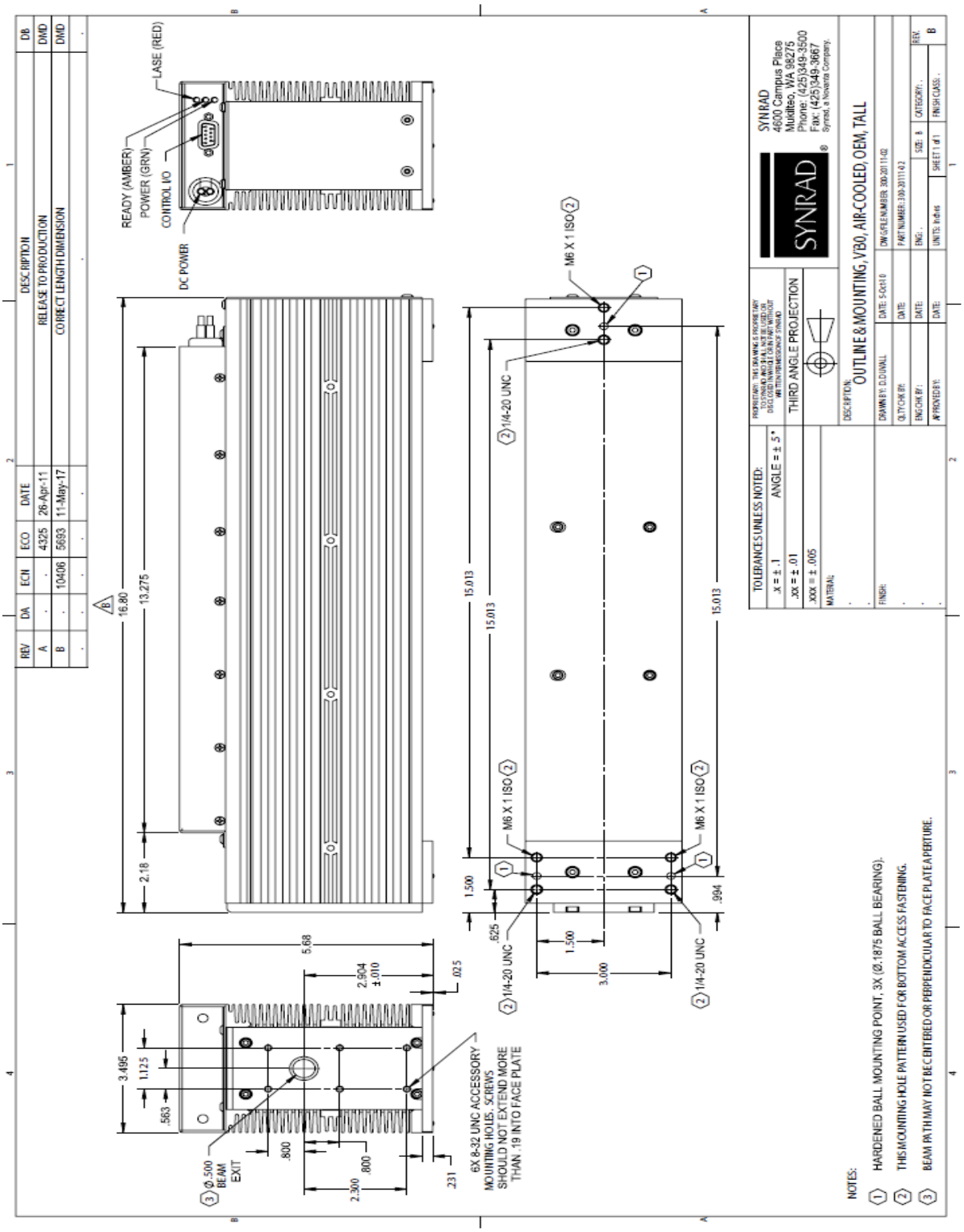


Figure 4-16 OEM vi30 package outline and mounting dimensions

With optional customer-installed ‘Tall’ mounting feet.

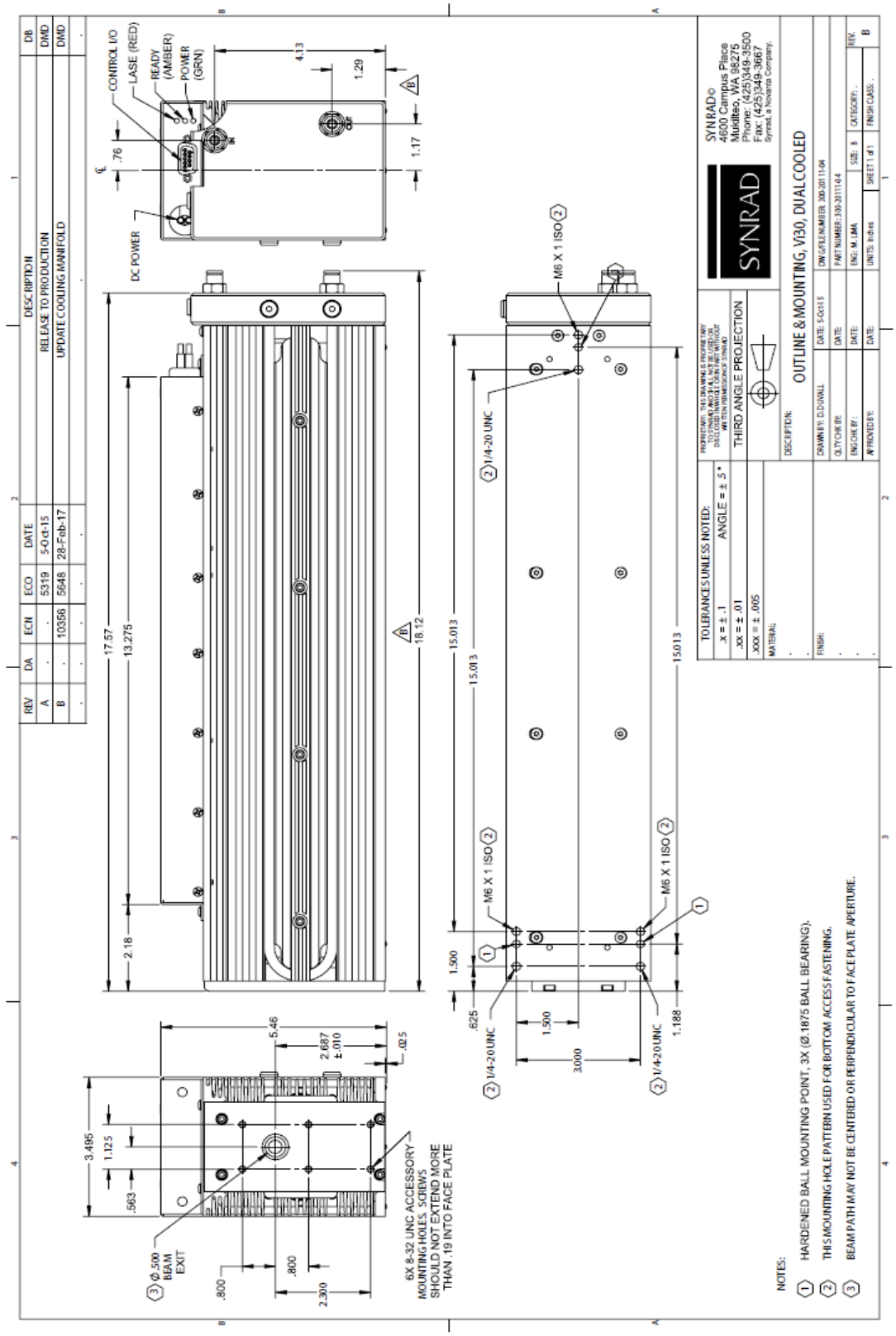


Figure 4-17 OEM vi30 Dual-cooled outline and mounting diagram

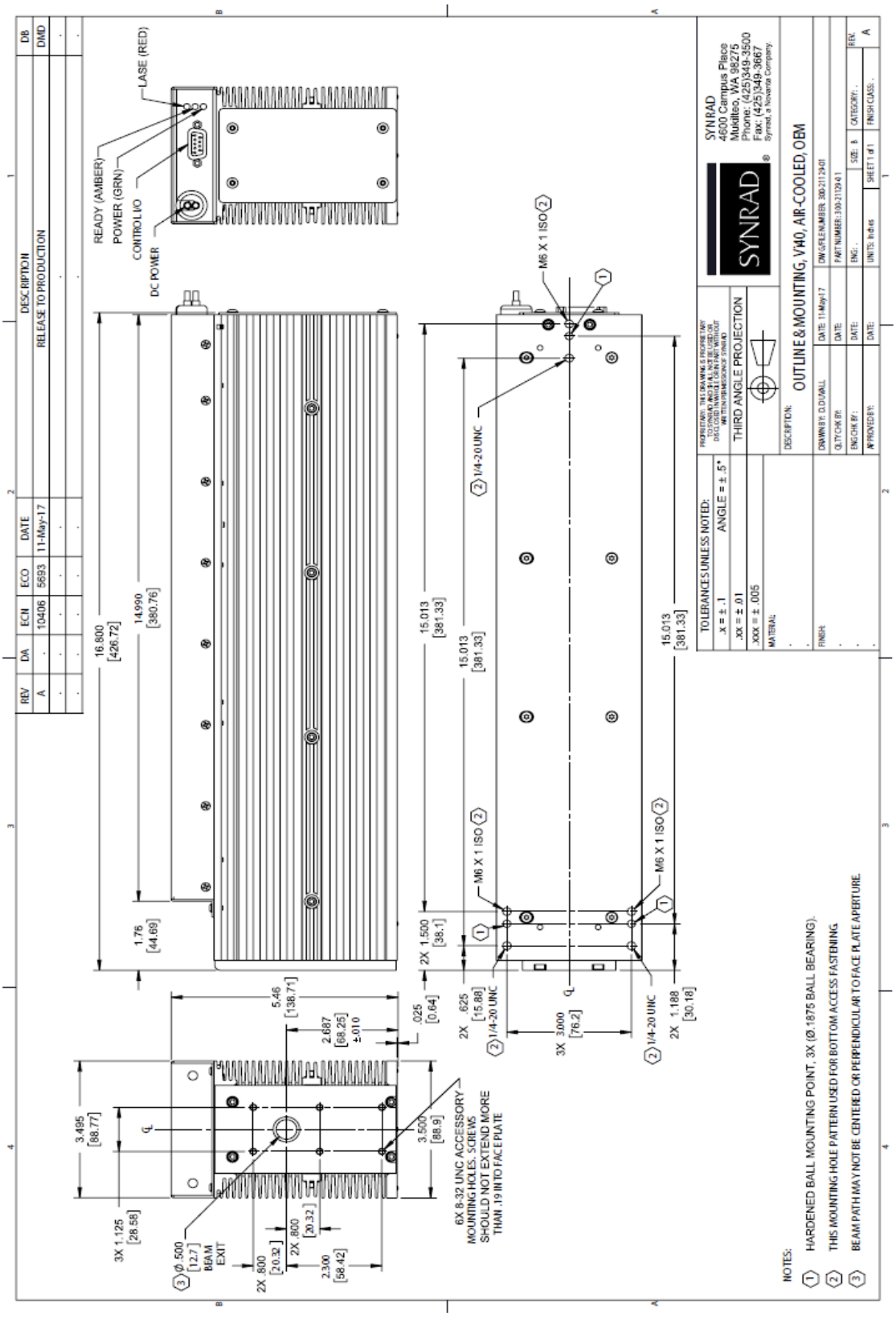


Figure 4-18 OEM vi40 Dual-cooled outline and mounting diagram.

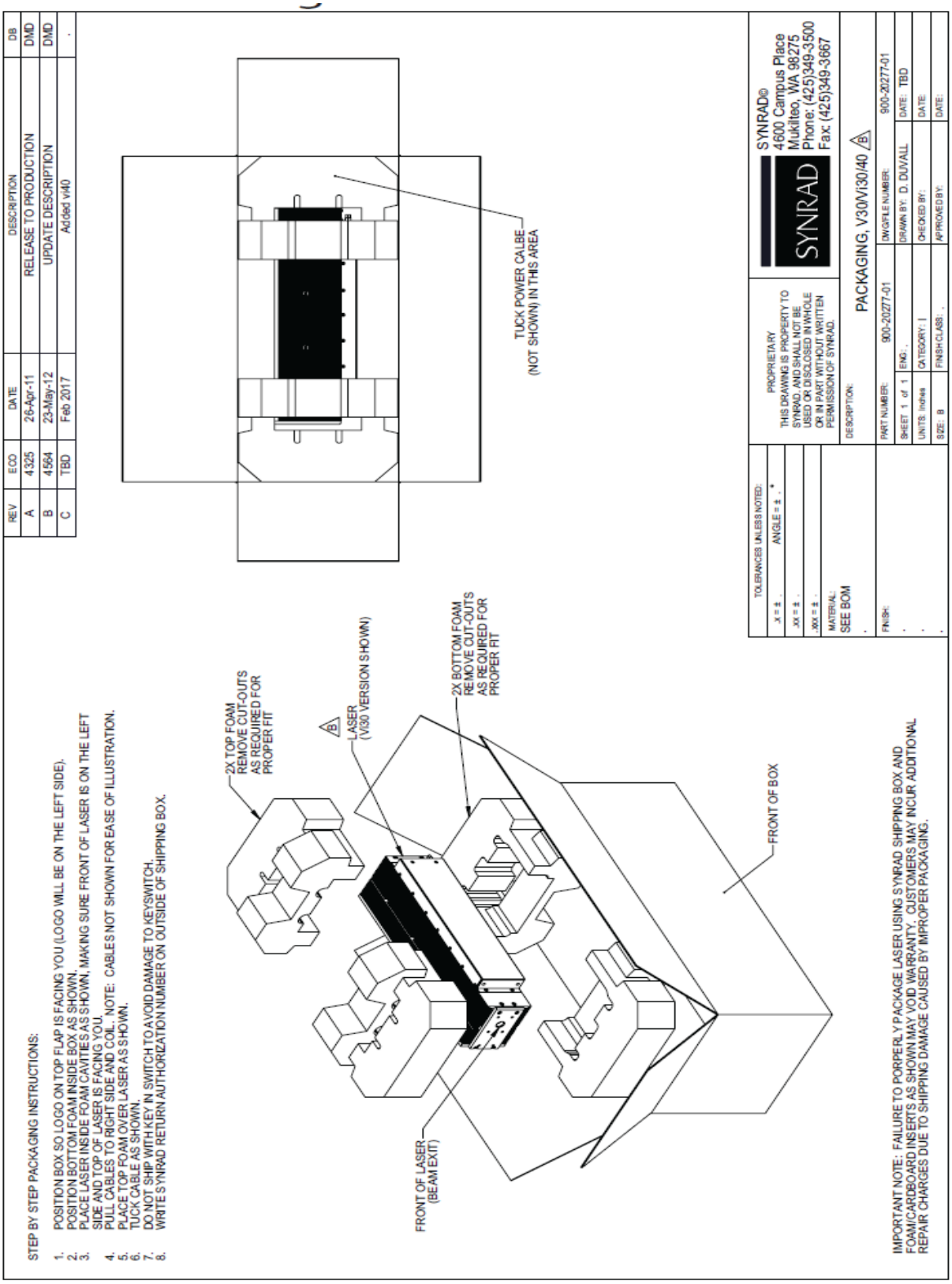


Figure 4-19 OEM vi30/40 packaging instructions.

Maintenance & Troubleshooting

This section contains maintenance and troubleshooting information for your vi30/40 laser.

Maintenance

The Maintenance section includes subsections:

- Disabling the vi30/40 laser
- Daily inspections
- Cooling
- Storage/shipping
- Cleaning optical components

Disabling the vi30/40 laser

Before performing any maintenance on your OEM vi30/40 laser, be sure to completely disable the laser by disconnecting the DC Power Cables from the DC power supply.

Daily inspections

Perform the following steps daily to keep your vi30/40 laser in optimum operating condition. Except for the procedures described below, no other service is required or should be attempted.

1. Inspect all cooling tubing connections for signs of leakage. Check for signs of condensation that may indicate the cooling water temperature has been set below the dew point temperature. Condensation will damage electrical and optical components inside the laser. See the Setting coolant temperature section in the Intro, and technical reference chapters for details on preventing condensation.
2. Inspect beam delivery components for signs of dust or debris and clean as required. When cleaning the optical surfaces of beam delivery components, carefully follow the manufacturer's instructions.

Caution: Possible Equipment Damage

Even small amounts of contamination on optics in the beam path can absorb enough energy to damage the optic. Inspect beam delivery optics periodically for signs of contaminants and carefully clean as required. In dirty environments, purge laser optics using filtered air or nitrogen to prevent vapor and debris from accumulating on optical surfaces.

If you operate the laser in dirty or dusty environments, contact SYNRAD® about the risks of doing so and precautions you can take to increase the longevity for the laser system and associated optical components.

3 Visually inspect the exterior housing of the laser to ensure that all warning labels are present. Refer to the Laser Safety chapter for vi30/40 label types and locations.

Cooling

Air cooling

Because vi30/40 lasers are OEM products, they do not include cooling fans. Customers must provide some type of air cooling to prevent the laser from overheating. NOVANTA recommends using two cooling fans rated for at least 4.0 m3/min (140 CFM) for the vi30 at a static air pressure of 13.9 mm H2O (0.52 in H2O). The cooling fans should measure 120 × 120 mm (4.7" × 4.7") and have at least 57.2 mm (2.25") of unobstructed clearance between the rear face of the fan housing and any mounting surface or enclosure. NOVANTA recommends 5.4 m3/min (190 CFM) for the vi40.

Water cooling

When filling your chiller, use at least 90% distilled or tap water by volume. If you must use glycol, do not add more than 10% by volume. See the vi30/40 technical reference section in this manual for detailed information.

Coolant temperature & flow rate

Set a chiller temperature setpoint between 18–22 °C (64–72 °F). The setpoint temperature MUST be maintained above the dew point temperature. Operating the laser with a coolant temperature below the dew point of the surrounding air may cause condensation to occur that will damage the laser. Cooling flow rate 1.0 GPM <60 PSI.

Storage/shipping

When preparing the laser for storage or shipping, remember to drain cooling water from the laser. In cold climates, any water left in the cooling system may freeze, which could damage internal components. After draining thoroughly, use compressed shop air at no more than 200 kPa (29 PSI)—Wear safety glasses! —to remove any residual water. When finished, cap all connectors to prevent debris from entering the cooling system.

When shipping NOVANTA lasers to another facility, we highly recommend that you ship the unit in its original NOVANTA shipping container. If you no longer have the original shipping box and inserts, contact NOVANTA Customer Service about purchasing replacement packaging. Refer to Packaging instructions in the Technical Reference section for detailed instructions on properly packaging the laser for shipment.

Important Note: Failure to properly package the laser using NOVANTA-supplied shipping boxes and foam/cardboard inserts as shown in the Packaging instructions may void the warranty. Customers may incur additional repair charges for shipping damage caused by improper packaging.

Cleaning optical components

Debris or contaminants on external beam delivery components may affect laser processing and lead to damage or failure of the optics and/or the laser. Carefully follow the steps below to inspect and clean the optical components in the beam path. Before beginning the cleaning process, read this entire section thoroughly to ensure that all cleaning materials are available and that each step is completely understood.

Important Note: Exercise great care when handling infrared optics; they are much more fragile than common glass materials. Optical surfaces and coatings are easily damaged by rough handling and improper cleaning methods.

Cleaning optics guidelines

- Wear latex gloves or finger cots (powder-free) to prevent contamination of optical sur-faces by dirt and skin oils.
- Never handle optics with tools; always use gloved hands or fingers.
- Hold optics by the outer edge; never touch the coated surface.
- Always place optics lens on a tissue or suitable equivalent material for protection; never place optics on hard or rough surfaces.
- It may be necessary to use a cotton ball or fluffed cotton swab instead of a lens wipe to uniformly clean the entire surface of small-diameter mounted optics.
- Before using any cleaning agents, read Material Safety Data Sheets (MSDS) and observe all necessary safety precautions.

Warning: Serious Personal Injury

Ensure that DC power to the laser is turned off and locked out before inspecting optical components in the beam path.

Invisible CO2 laser radiation is emitted through the aperture. Corneal damage or blindness may result from exposure to laser radiation.

Required cleaning materials

The table below lists the type and grade of materials required to properly clean optical surfaces.

Table 5-1 Required cleaning materials.

Cleaning Material	Requirements
Latex gloves or finger cots	Powder-free
Air bulb	Clean air bulb
Ethyl or isopropyl alcohol	Spectroscopic or reagent grade
Acetone	Spectroscopic or reagent grade
Lens wipe (preferred)	Optical (clean-room) quality
Cotton balls or cotton swabs	High-quality surgical cotton/high-quality paper-bodied

Caution: Possible Equipment Damage

Do not allow the nozzle of the air bulb to touch the optical surface. Any contact may damage the optic by scratching coatings on the optical surface.

Do not use compressed shop air to blow contamination from the optic. Compressed air contains significant amounts of water and oil that form adsorbing films on the optical surface.

Do not exert pressure on the surface of the optic during cleaning. Optical surfaces and coatings are easily scratched by dislodged contaminants.

Use a new lens wipe on each pass as contaminants picked up by the wipe may scratch the optical surface.

1. Shut off and lock out all power to the laser. You must verify that the laser is OFF (in a zero-energy state) before continuing with the optical inspection!
2. Visually inspect all optical surfaces in the beam path for contaminants.
3. Remove loose contaminants from the optic by holding a clean air bulb at an angle to the optic and blow a stream of air at a glancing angle across the lens surface. Repeat, as necessary.
4. Dampen a lens wipe with the selected cleaning agent. Alcohol (least aggressive) is best for initial surface cleaning. Acetone (moderately aggressive) is best for oily residue or minor baked-on vapors and debris.
5. Gently, and without applying pressure, drag the damp lens wipe across the optical sur-face in a single pass. Do not rub or apply any pressure, especially when using a cotton swab. Drag the wipe without applying any downward pressure. Use a clean lens wipe on each pass. The wipe will pick up and carry surface contaminants that may scratch optical surfaces or coatings.
6. Carefully examine the optic under suitable lighting. Certain contaminants or damage such as pitting cannot be removed. In these cases, the optic must be replaced to prevent catastrophic failure.
7. Repeat Steps 4 through 6 as required, removing all traces of contaminants and deposits.

Important Note: To prevent streaking during the final alcohol cleaning, drag the lens wipe slowly across the surface so that the cleaning liquid evaporates right behind the wipe.

If acetone is used as a cleaning solvent, a second follow-up cleaning of the optical surface using alcohol is required.

Troubleshooting

The Maintenance section includes subsections:

- Introduction
- Operational flowchart
- Functional block diagram
- Status LEDs
- Laser fault indications

Introduction

The Troubleshooting section is designed to help isolate problems to the module level only. Problems on circuit boards or the laser tube are outside the scope of this guide because they are not user-serviceable assemblies; do not attempt to repair them. Contact NOVANTA or a NOVANTA Authorized Distributor for repair information.

To troubleshoot vi30/40 lasers, it is necessary to understand the sequence of events that must happen before the laser can operate. Before attempting any service, we advise you to read the entire troubleshooting guide and review both the operational flowchart and the functional block diagram.

Caution: Possible Equipment Damage

Attempting repair of a NOVANTA laser without the express authorization of NOVANTA, will void the product warranty.

If troubleshooting or service assistance is required, please contact NOVANTA Customer Service.

Status LEDs

Three status LEDs on the rear of the OEM vi30 laser provide a visual indication of operating status. A green PWR LED illuminates when DC power is applied to the laser. The yellow RDY LED indicates that a Laser Enable signal has been applied and that, after a five-second delay, lasing will begin once a PWM Command signal is received. The LASE LED illuminates red to indicate that the PWM signal is sufficient to induce laser output. See the following pages.

Operational flowchart

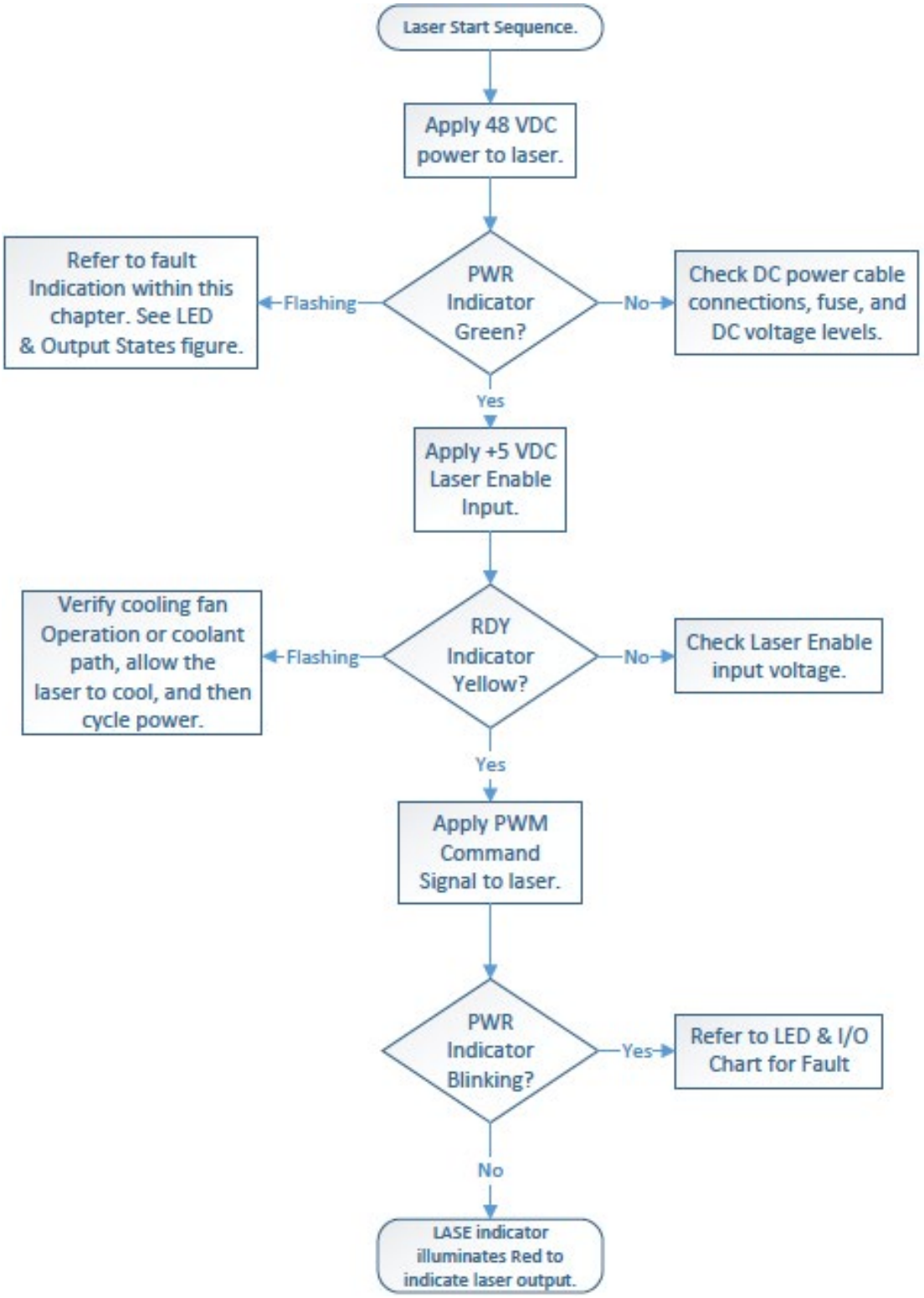
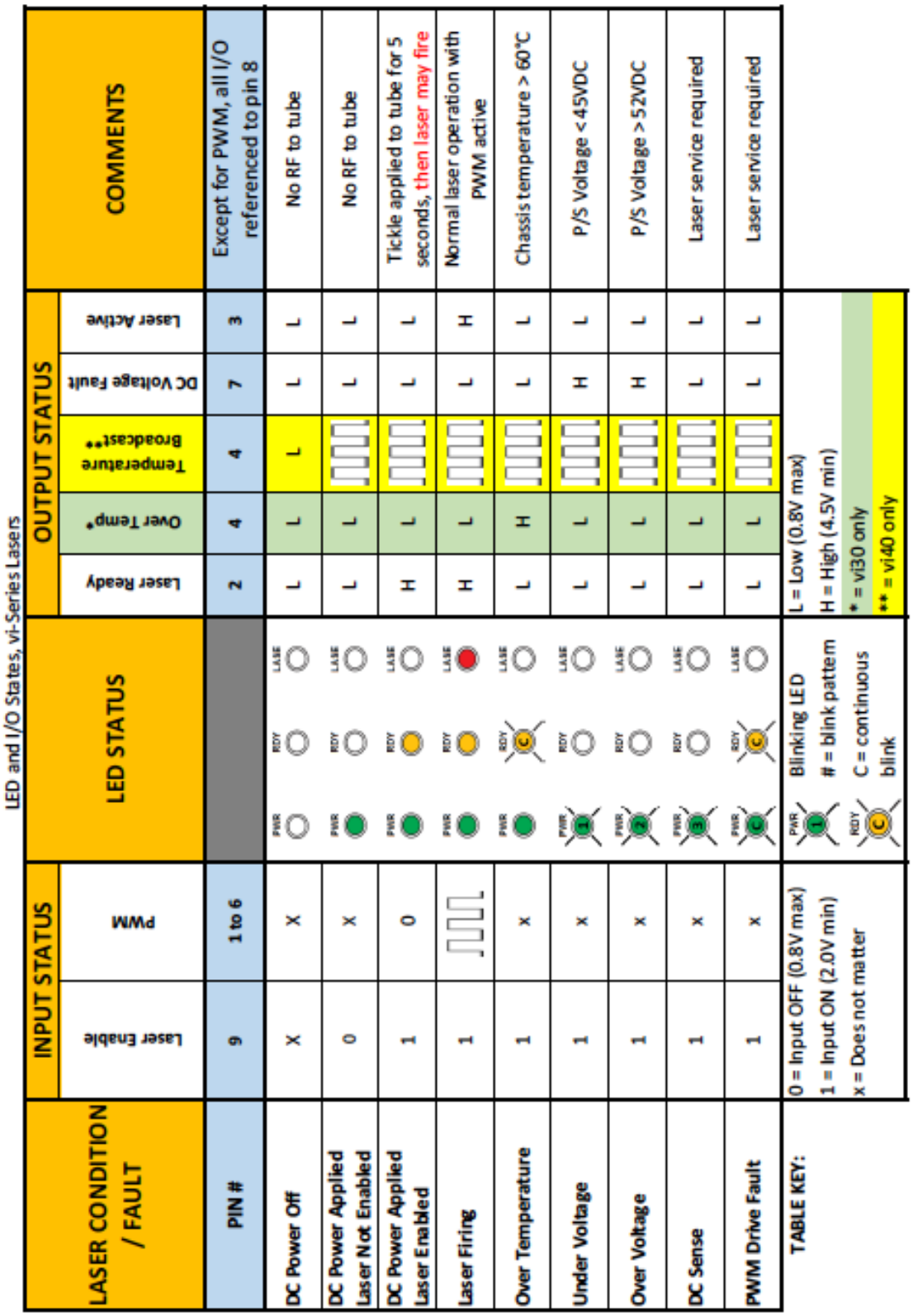


Figure 5-1 vi30/40 operational flowchart.

Status LEDs

Table 5-2 vi30/40 Input I/O status states.



OEM vi30/40 LED indicators, in conjunction with the DB-9 I/O outputs, provide status information to the user. The prior table shows LED indicator and output signal states during normal and fault conditions.

On OEM vi30/40 lasers, the PWR indicator illuminates green on DC power-up. The RDY LED illuminates yellow when a Laser Enable signal is applied and after a five-second delay, customer-supplied tickle signals are passed through to the RF driver. When PWM Command pulses are applied (and are long enough to produce laser output) the LASE LED illuminates red.

Laser fault indications

OEM vi30/40 lasers can indicate five specific fault conditions. In the event of certain faults, the RDY LED, PWR LED or both will blink an error code, pause 1/2 second, and then repeat the code. This sequence continues until the fault is corrected and the laser is reset by cycling DC power to the laser.

Warning: Serious Personal Injury

Ensure that DC power to the laser is turned off and locked out before inspecting optical components in the beam path. Invisible CO_2 laser radiation is emitted through the aperture. Corneal damage or blindness may result from exposure to laser radiation.

Resetting faults

Over temperature fault

Over temperature faults occur when thermal limits in the laser are exceeded (RDY indicator flashes continuously; PWR LED remains solid green). To reset an over temperature fault, cool laser chassis temperature below 60 °C and then cycle DC power. When the RDY LED illuminated without flashing, lasing is enabled.

Under Voltage fault

An under-voltage fault occurs when the DC input voltage is at or below 45 VDC. This fault is indicated by the PWR indicator flashing 1 blink at 1/2 second intervals. To reset an under voltage fault, ensure that 48 VDC is applied to the laser under full-load conditions and then cycle DC power. When PWR and RDY indicators illuminate, lasing is enabled.

Under voltage faults are typically caused by the DC power supply being unable to properly regulate output voltage under full-load or high inrush current conditions. Improper regulation may be caused by an undersized DC supply or insufficient AC line voltage.

Over Voltage fault

An over voltage fault occurs when the DC input voltage is at or above 52 VDC. This fault is indicated by the PWR indicator flashing 2 blinks at 1/2 second intervals. To reset an over voltage fault, ensure that 48 VDC is applied to the laser under full-load conditions and then cycle DC power. When PWR and RDY indicators illuminate, lasing is enabled.

DC Sense fault

An DC Sense fault is indicated by the PWR indicator flashing 3 blinks at 1/2 second intervals. If this fault occurs, the laser requires service—contact NOVANTA or a NOVANTA Authorized Distributor.

PWM Sense/Control Board fault

A PWM Sense or control board fault is indicated by both RDY and PWR indicators flashing continuously. If this fault occurs, the laser requires service—contact NOVANTA or a NOVANTA Authorized Distributor.

Symptom:

- The power supply is connected, and the voltage is correct, but the PWR LED is not on.

Possible Causes:

- The fast-acting fuse has blown.

To replace the fuse, open the in-line fuse holder by twisting the upper half 1/4 turn counter-clockwise. Remove the fuse and replace it with an appropriate fast-acting fuse (see Operation and/or Getting Started Chapter for more vi30/40 fuse replacement information).

Beam delivery optics

Symptom:

- The laser loses power over time; laser output power must be increased to maintain previous performance.

Possible Causes:

- Beam delivery optics are coated by vapor residue or debris

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